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The Amsterdam International Congress

This gathering attracted an attendance which we estimated to number about 250, drawn from more than a dozen countries. Mr. F. W. E. Spies, the president of the Dutch Technical Foundry Association, well merited the eulogies so brilliantly expressed by Mr. R. Deprez, the Belgian president of the International Committee of Foundry Technical Associations. He presided with great dignity, using either English or French as circumstances warranted, but kept his speeches commendably short. His opening address was delivered in Dutch, but the visitors were provided with translations so that his message was easy to follow. The organisation, under the leadership of Ir. A. Baron Krayenhoff, had provided an excellent well-balanced technical and social programme. Committee work prevented our attending much of the technical sessions, but the general gossip was that the discussions were at high levels and distinctly useful. We did, however, manage to participate in five works visits. The quality of the castings made was of a really high standard. The older foundry equipment is predominantly German, but for the post-war additions there is a quantity of British. In one case we noticed amongst these an important unit bearing no nameplate. The hospitality given by the various works was a combination of quality and quantity associated with a homely atmosphere that ensured good fellowship.

On the social side, the event which gained the enthusiastic approval of all the visitors was a show at Harlem of Dutch costumes ranging from Louis quatorze to 1900. The compère was an obvious connoisseur and an actor of outstanding ability. The trip through the canals down to the docks was also an acceptable and interesting break in the *work* of the Congress. We have stressed the word "work," for in truth we, in common with others, must have averaged an eighteen-hour day.

The moment seems opportune to review briefly just what has been accomplished by these international gatherings, of which about 15 have been held in ten different countries. Between 150 and 200 of the world's best foundries have been visited and foundry technical literature has been enlarged by the presentation of between 350 and 500 Papers. They have probably been the cause of the creation of a minimum of three new national foundry technical associations.

This important manifestation of the gathering at Amsterdam has not only worthily maintained the standards set by earlier congresses, but, by a display of organising ability, hard work, coupled with courtesy, kindliness and good humour, has enhanced the prestige of the International Committee of Foundry Technical Associations. On behalf of the 43 British participants, we write with a profound feeling of cordiality: *Dank U Seer.*

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Midland Ironfounders' Association

Annual Meeting in Birmingham

The annual general meeting of the Midland Ironfounders' Association was held last week at the Queen's Hotel, Birmingham, and was attended by a large percentage of the members. The chair was taken, initially, by Mr. W. H. Thursfield, deputy chairman of the Association, in the absence of Mr. D. H. Wood, whom it was announced has had to tender his resignation on medical advice. Other prominent persons at the meeting included Mr. Noel P. Newman, president of the Council of Ironfoundry Associations (also president of the National Ironfounding Employers' Federation and the Institute of British Foundrymen; Mr. Kenneth Marshall, director of the Joint Iron Council; Mr. T. Parkinson, secretary of the C.F.A.; Mr. G. B. Judd, representing the secretaries of the N.I.E.F., and Mr. R. F. Baird, secretary of the Midland Association.

Presenting the Chairman's report, Mr. Thursfield prefaced his remarks by referring to the resignation of Mr. D. H. Wood and paid tribute to his services to the Association. He added that a presentation of a silver salver had been made a week earlier to Mr. Wood on behalf of the Association.

Mr. Thursfield went on to quote figures for the saving in national grid electricity which members had been able to achieve by installing their own generating plant, the overall figure being 34 per cent. where such equipment had been put into use. Other members, by economies and re-arrangement, had saved 17 per cent. of their loads.

Advisory Panels

It was felt that, while there was no general basis for criticism which had been levelled in certain quarters against the efficiency of foundries, there were a few directions in which individual members might profit from the collective advice of others. In this connection advisory panels had been set up, comprised of some 20 to 30 experts, to deal with (*a*) management, layout and plant; (*b*) practical foundry technique and metallurgy; (*c*) working conditions, amenities, personnel relations and training, and (*d*) finance, accounts costing and prices; these would visit members on request.

Consideration was asked from members for the project of forming an Anglo-American productivity team, it being thought that some foundries might find a visit to America to be worthwhile.

National Foundry Craft Training Centre

Disappointment was felt that Midland members, generally, had not made more use of the facilities available at West Bromwich for the training of apprentices. The provision of a hostel for the students and, staff was announced and the help of founders with the supplying of patterns for setting exercises for the boys was enlisted.

The chairman concluded the report by referring briefly to prices and by quoting production and wages statistics for the area. He asked for future returns of figures to be made promptly.

The next business before the meeting was the election of officers. Mr. J. W. Gardom was unanimously elected as independent chairman and Mr. W. H. Thursfield as vice-chairman for the coming year. For the council, all the retiring members who expressed willingness to serve again were re-elected. Mr. E. Hunter (Incandescent Heat Company, Limited) was elected to fill the place of Mr. A. E. Kenrick, who asked to be excused from further service. The auditors, Heath & Coleman, were re-elected. Mr. Gardom then took the chair for the remainder of the meeting.

The assembly was next addressed by Mr. N. P. Newman, who emphasised the potential value to members of the newly appointed advisory panels. He repeated a warning made by Mr. Thursfield on the dangers attendant upon indiscriminate price-cutting.

Status of the Industry

Mr. Kenneth Marshall, in the course of remarks on the relations between the constituent members of the foundry associations, said that greater decentralisation of committee work was desirable. The industry was, he quoted, well-thought-of by the Government, and proposals by certain sections for a Working Party had been turned down Ministerially because of danger of over-lapping. There was, however, Mr. Marshall added, the need for continued effort towards increased efficiency and to that end he advocated widespread use of the new advisory panels.

Mr. T. E. Parkinson, C.F.A., secretary, reported on the various activities of the Council, of which the Midland Ironfounders' Association is a constituent body. Output of ironfoundries was, he said, about 5 per cent. down in the second quarter of 1949, and this decrease was associated with all sections except for building and domestic uses where little change had taken place. Automobile castings had suffered a 10 per cent. decline in output. Materials, generally, were easier, there being an increase in pig-iron stocks of 40,000 tons over the last quarter, though, taken as a whole, low-phosphorus varieties were still in short supply. More scrap had been used because more was made available. Details were required from members about the quality of coke recently delivered—it was hoped some improvement would be seen. As regards the work of the Steering Committee, Mr. Parkinson reported a decrease in volume of schemes, but said those relating to provision of amenities were well maintained. Recruitment had been stimulated in several directions and the showing of the new film "Casting in Iron" and the demonstration staged at Walsall offered new possibilities of interesting school leavers.

Mr. Davies, Regional Controller for Industry of the Ministry of Supply, who was present as a guest, congratulated founders on their achievements and offered the help of his department to all who required it. The final speaker, Mr. G. B. Judd, gave a brief *resumé* of the work of the Advisory Panel of the South of England Ironfounders' Association, which, he said, was proving very helpful and was being made very welcome on its visits to foundries in his area.

A single item in the discussion related to a question by Mr. R. F. Baird about the setting up of new foundries. Mr. Parkinson replied that anyone who could get a building licence and a supply of pig-iron could start a foundry. This terminated the proceedings.

Some Notable Aluminium-alloy Castings*

Details Special Production Methods

By A. R. Martin, B.Sc., A.R.S.M.†

SYNOPSIS

This Paper is, for convenience, divided into three sections:—(1) A description of two types of intricate, high-strength alloy sand castings. (2) Examples of intricate gravity die-castings, one in high-strength alloy together with further examples of high-strength gravity die-castings of a more straightforward nature. (3) Examples of finned, air-cooled cylinder-head castings, one cast in sand and the other gravity die-cast in an evacuated die. The castings have been chosen to illustrate, not only the specialised technique and metallurgical control necessary for the production of castings in the high-strength aluminium alloys, but, where possible, points of interest relating to die design and the construction of pattern and core-box equipment.

Characteristics of the Alloys Used

The two binary aluminium alloys containing 10 per cent. magnesium and 4½ per cent. copper respectively have been developed comparatively recently though they made their appearance in 1936-39. They are remarkable, not so much for their high proof-stress and ultimate tensile strengths but for their ductility. The 10 per cent. magnesium alloy—specification DTD 300—is particularly useful where ability to withstand shock loading is important and its application during world war II, towards increasing the payload of aircraft by replacing built-up welded steel structures, gained for it an enviable reputation. Against these desirable features must be set a high rate of oxidation during melting and holding; attack of the metal at the mould face by the moisture contained in the moulding sand; a tendency to intercrystalline shrinkage porosity in inadequately fed portions of the castings; extreme susceptibility to handling and contraction cracks immediately after casting and brittleness in the as-cast condition.

The 4½ per cent. copper alloy—specifications DTD 298 and 304—being free from magnesium, does not present the same oxidation problems, nor does it suffer from intercrystalline shrinkage, but castings in this alloy still require adequate feed and the alloy is extremely hot-short. Except for straightforward castings with ample radii on all contours and freedom from sudden changes of section, the alloy is unsuitable for the production of die castings.

Three other alloys are used for the production of castings to be described. Two of them, the eutectic 12 per cent. silicon alloy BS 2L33 and "Y" alloy, are amongst the original commercial aluminium casting alloys. BS 2L33 is an alloy possessing excellent fluidity, enabling intricate castings of thin section to be run under almost any conditions. However, its feeding characteristics depend on the state of "modification," and this factor can be troublesome at times. "Y"-alloy, the original heat-treated aluminium alloy developed by the National Physical Laboratory, is still the best alloy for castings which are stressed at high temperatures, but it too possesses a tendency toward oxidation troubles and inter-crystalline shrinkage porosity (detrimental alike to tensile properties and pressure tightness) and is extremely hot-short. The third alloy, a 5 per cent. silicon, 1½ per cent. copper, ½ per cent. magnesium alloy, specifications DTD 272 and 276, is a heat-treated medium-strength alloy possessing the ability to run moderately intricate castings of thin section and possessing reasonably good rigidity at elevated temperatures, which property makes it suitable for use in the majority of cylinder-head applications.

The Castings to be Described

The two examples of high-strength sand castings are in DTD 300; a bomb-rack casting for a fighter bomber and two ordnance castings of a similar type, which presented an unusual problem in core-box design. The first example replaced a fabricated light-alloy component and the two castings in the second group replaced welded-steel components. First in the gravity die-cast section are a range of sink units cast in BS 2L33 alloy with a double or single draining-board cast integrally. This range of castings, because of their size, present a problem in die distortion as well as a problem in casting technique. An intricate high-strength die-casting in DTD 300—an aircraft rudder pedal (also replacing a built-up component)—affords an illustration of how die design and casting technique can overcome the susceptibility of the alloy to contraction and handling cracks.

Further examples of high-strength gravity die-castings are afforded by an aircraft-engine support member cast in DTD 300—almost an ideal design for a die-casting—and a range of tool-holders and pulley wheels, for large capstan lathes, cast in the 4½ per cent. copper, DTD 304, alloy. In the heat-treated condition, corresponding to DTD 304, this alloy has a higher proof stress than DTD 300, which is essential for giving the rigidity required in this application.

Finally, the two examples of cylinder-head technique are provided by the sand-cast head of a four-cylinder

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Some Notable Aluminium-alloy Castings

motor-cycle engine and a die-cast air-cooled aircraft engine cylinder-head. The motor-cycle head, owing to its complexity, is built up in a simple-cavity mould from fifteen cores. In addition, since the head is jig-machined, strict dimensional tolerances have to be adhered to, and the means whereby the various cores are located are ingenious. The air-cooled aircraft-engine head is a good example of what may be achieved in the way of cooling-fins cast under vacuum.

INTRICATE HIGH-STRENGTH ALLOY SAND CASTINGS

Both these castings are in DTD 300 alloy, which is produced to the following specification requirements.

Chemical Composition. — Cu 0.15 per cent., max.; Mg 9.5 to 11.0 per cent.; Si 0.35 per cent. max.; Fe 0.35 per cent. max.

Tensile Properties.—17 tons per sq. in. 7 per cent. elongation. (0.1 per cent. proof stress should not be less than 10 tons per sq. in.).

Bomb-rack Casting for Fighter Bomber Aircraft

This casting was originally designed to carry a 330-lb. bomb load under an acceleration of six times gravity. A reserve factor of two was applied which was equivalent to a static load of 4,000 lb. Later, the loading was increased to 500 lb., which, with the same acceleration and reserve factors, raised the equivalent static load to 6,000 lb. This load was suspended from the transverse members and a hoisting pulley was attached to the boss on the curved, box-section transverse member.

The casting measured approximately 26 in. by 14 in. by 3 in. deep, and the sections were $\frac{5}{16}$ in. thick with flanges $\frac{1}{4}$ in. wide. The weight as-cast was 31 lb., fully fettled it weighed only 11 lb. The pattern-plate equipment and core-box equipment shown in Fig. 1 were cast in BS 2L33 alloy. The bosses on the curved cross-tube and a small boss on the side member were formed by loose pieces, the remaining undercut sections being produced by eleven cores. Riser patterns were integral with the pattern plate and the risers were subsequently opened by hand. Runners and gate were also embodied in the pattern equipment. At first, the casting was bottom-gated but, due to shrinkage troubles, the casting later was top-gated so that metal entered the casting immediately under a riser. Cast aluminium-alloy moulding boxes were used, 28 in. by 21 in. by $4\frac{1}{2}$ in. deep, a support bar being cast in the cope box.

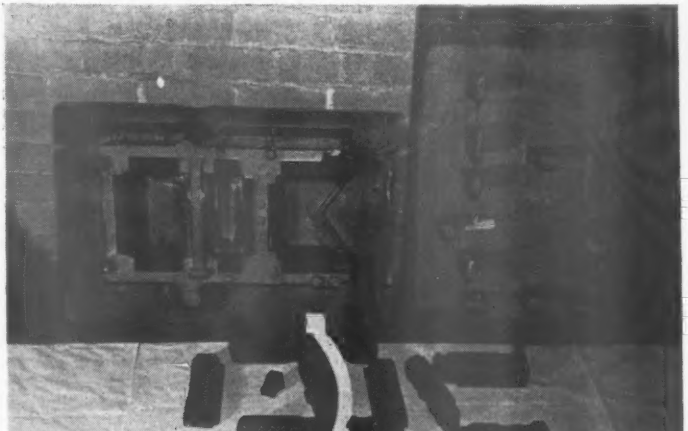


FIG. 1.—PATTERN-PLATE EQUIPMENT AND A SET OF CORES FOR THE BOMB-RACK CASTING.

Moulding Sand

Moulding and core sands must be inhibited to prevent attack of the magnesium by moisture. After trying all the usual methods applied to the magnesium-base casting alloys, it was found that the sands could be most effectively and conveniently inhibited by the addition of boric-acid powder. Quite large castings can be thus produced completely free from "sand attack," and the fumes evolved during casting are not too unpleasant. Although it may appear unnecessary, baked cores also need inhibiting. The moulding sand used is essentially a silica sea sand and natural clay-bonded sand mix to which an addition of boric acid is made. The properties aimed at are:—A.F.S. permeability 70-90 units; green compression strength, 4-6 lb. per sq. in., and moisture not more than 5 per cent. This sand is re-milled after use, with fresh additions of water and boric acid and of either the silica sand or the natural clay-bonded sand. Frequent tests are made on the properties and boric acid content of the sand and the quantities of the various additions to each mix depend on the trends shown by graphs of these properties.

The core sand is based on silica sand with additions of cereal binder, a small amount of natural clay-bonded sand, boric acid and linseed oil. Average properties for this sand are:—A.F.S. permeability 120 units, and baked compression strength, 400 lb. per sq. in. Owing to the risk of contraction cracks, baked strengths of over 500 lb. per sq. in. should be avoided. In this connection the boric-acid content must be

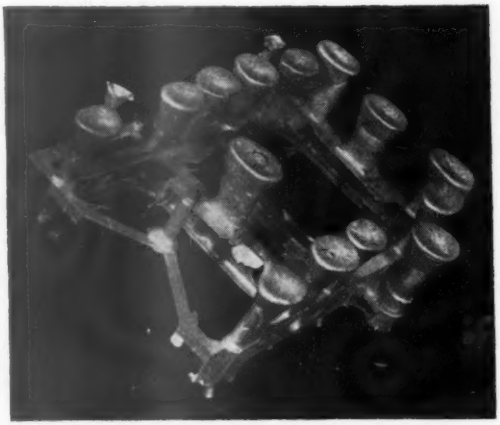


FIG. 2.—BOMB-RACK CASTING SHOWING THE POSITION OF RUNNERS AND RISERS.

carefully controlled, since increasing boric acid will increase the baked strength of the cores.

Metal Melting and Treatment

Melting and metal treatment prior to casting play an important part in the production of successful castings in DTD 300 alloy. Elaborate gating techniques to avoid turbulence and to skim the metal as it enters the mould are of no value if the metal be in poor condition. Crucible melting is preferred, and the need for cleanliness of crucibles, furnace tools and ladles cannot be too highly stressed. Any scrap re-charged in the circuit should be good clean metal, free from dross and moulding sand, and be of reasonable size so as not to introduce undue oxide during melting. The charges of ingot and scrap are melted down under a flux cover of sodium-free salts. This flux cover is not removed until the metal is ready for pouring. Transferring from the melting furnaces to the bale-out holding furnaces, adjustment of temperature and de-gassing are all carried out under flux.

Stringent control of the temperature of the molten metal is essential and, during melting, ingot and scrap should be charged continuously so that it is preheated before it reaches the molten metal. It is bad practice to allow part of the charge to become completely molten and then to add the remainder, as serious gas pick-up can result. If the metal has to stand in the molten state for any length of time it should not be allowed to rise above 670 to 680 deg. C. Of the several methods available for de-gassing aluminium-base alloys, nitrogen has been found the most effective for DTD 300. Its efficiency has been proved over a number of years, and furthermore it is easy to handle and produces no objectionable fumes. The metal is always de-gassed immediately prior to casting because of its capacity for rapid gas absorption. The technique employed is as follows:—The burners are shut off and de-gassing commenced. At the end of the five minute de-gassing period, the residual heat in the furnace should have raised the metal temperature to the highest casting temperature required and then the metal is withdrawn immediately. Ladles are well preheated for this purpose and must not be warmed in the metal.

Casting Technique

The position and size of the gate and risers may be seen from Fig. 2. The casting is gated at five points along one side from two separate runners and sprues. Chills are placed under the bosses at each end of the curved cross tube; on the small bosses on the cross tube; on the three pads on the closed end of the frame, and on the outsides of the bosses on each side of the frame on the open end. A small chill is included on the core which forms the boss at the open end of the frame on the gated side. The mould is placed on a plate and tilted for pouring so that the metal runs uphill from the gates. The casting is poured at 720 to 730 deg. C., and the mould is lowered as pouring proceeds. Pouring is stopped when the level of the metal is within one inch of the top of the risers. Fresh hot metal is then added to the risers. This precaution is necessary to avoid surface shrinkage under the base of the risers which otherwise tends to occur. The fettled casting is illustrated in Fig. 3.

Heat-treatment and Inspection

Heat-treatment is carried out in electrically-heated, forced-air, circulatory furnaces of the vertical pit type. For DTD 300 alloy, a 12 to 16-hour soak at 425 deg. C. is followed by a hot oil quench. Even so, distortion

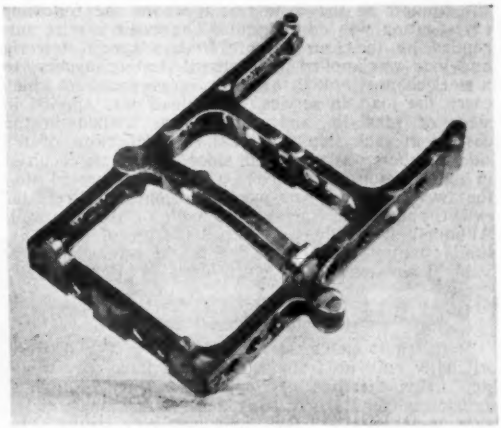


FIG. 3.—BOMB-RACK CASTING (DTD 300 ALLOY), AFTER FETTLING.

Some Notable Aluminium-alloy Castings

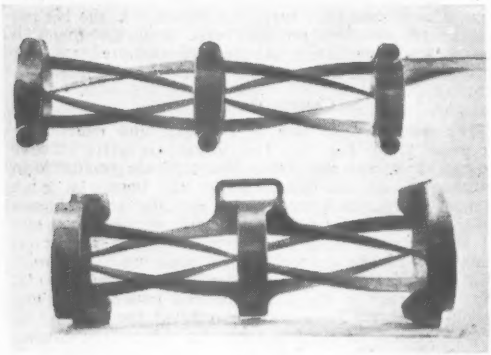


FIG. 4.—ORDNANCE COMPONENTS SAND-CAST IN DTD 300 ALLOY.

can be a problem, and these castings are packed on the cage standing vertically on their closed end. Owing to the ductility which the alloy possesses, any distortion could be corrected by setting the casting to a jig with a raw-hide mallet. Visual inspection for cracks is carried out conveniently by the chalk test, and to satisfy the Air Ministry demands the casting is radiographed in ten positions.

As an illustration of the effect of small defects on the strength of the casting as a whole, the following investigation was carried out. The castings were suspended by the four corners from a special test rig and load was applied in the tensile testing machine to a steel channel bolted to the two cross members which carry the load in service. The load was applied in steps of 1,000 lb., and a mark was scribed on the casting at each step. At first, the deflection of the side members was measured, since the defects occurred in these regions. However, a few tests showed that the two cross members were deforming to a greater extent, and measurements were made on these as well. Although the castings contained defects of quite dissimilar nature, position or degree, the results given in Table I are remarkably consistent.

TABLE I.—*Tensile Tests on Defective Bomb-rack Castings.*

Defect.	Yield stress in lb.		Max. load in lb.	Remarks.
	Side member.	Cross member.		
No defect	13,000	—	—	—
Small crack in side member flange	12,000. No permanent set. Shear fracture in middle cross member at 13,500 lb.		Bolt sheared 12,600 lb.	
Large crack in side member flange	14,000	10,000	15,000	Severe deformation of cross member
Number of small cracks	13,000	9,000	15,000	As above
General gas porosity	12,000	10,000	13,500	As above

Ordnance Components

These components. seen as castings in Fig. 4, were originally built up from steel tube and sheet by welding. Later, the tube was replaced by three rings in a similar manner to the casting, but the resulting articles were unnecessarily heavy and not very strong. In addition, the difficulty in producing a smooth helix on the four ribs resulted in a total fabricating time of something like 250 man-hours. The production of these components as castings resulted, not only in a lighter, more satisfactory article, but cut the fabrication time to at least one-twentieth the figure quoted. Cast in DTD 300 alloy, the larger casting was 28 in. overall length by 9 in. dia. and weighed 10 lb. when fully fettled. The smaller casting was 35 in. long by 6 in. dia. and weighed 8½ lb. when fully fettled. The average thickness of section was $\frac{3}{16}$ to $\frac{1}{4}$ in.

Core-making and Pattern Equipment

To produce smooth ribs it was evident that to make a core in several pieces would be impracticable. where would be the risk of slight cross-joints and also of flash, both being defects which would increase dressing costs. The notion of making the cores in one piece presented the problem of removing those portions of the core box which were to form the ribs.

FIG. 5.—CORE BOX WITH HELICAL BLADES PARTLY WITHDRAWN.

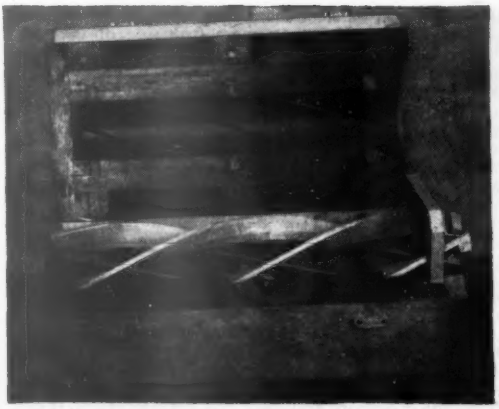


FIG. 6.—CORE BOX WITH BLADES IN POSITION.

This problem was eventually overcome by making helical ribs in metal and withdrawing them through a metal stripping plate in the end of the core box. The method of accomplishing this is illustrated in Figs. 5 and 6. The core boxes themselves were made in mahogany and were slotted to receive the metal ribs. The smaller core carried a projection on one end and this conveniently allowed the core to be rammed up through the stripping plate which was made sufficiently thick to form the projection. Fig. 5 shows the ribs partly withdrawn and in Fig. 7 the stripping plate has been withdrawn to allow the core to be removed. The larger core carried no such convenient projection and to form this the method finally adopted was simply to ram the core through the top half of the core box and to use a strickle to produce the required form. The partly strickled core is shown in Fig. 8.

The method by which the metal ribs of the pattern were made may be of interest. A cylinder of wood was prepared and the helix was marked-out along its length. The cylinder was then cut along this line to its axis. A length of wood was next fitted to this form and, when a satisfactory fit had been obtained, the width of the rib was scribed on it. The rib was then cut away and the necessary radial taper was applied. No taper was allowed along the length of the rib and in practice the twisting of the blade as it was withdrawn from the core box was sufficient to produce a clean draw. The rib blades were cast from the wooden master in BS 2L33 alloy in a two-part mould, gated along one edge. After fettling, the blades were set to the original form on the cylinder and then fitted to the core box. The actual time taken to make the blades was 40 man-hours, but fitting four blades to a core box took 300 man-hours. Even so, the time taken was lower in relation to the 250 man-hours required to weld a single component in steel. The actual time to produce a finished casting was less than 12 hours. The patterns for these castings also were made in mahogany and were completed in a matter of some 100 hours each.

The same core sand was used as already described. The cores were rammed up around a 1-in. dia. perforated brass tube for support and were turned-out on to an oil-sand carrier for passage through the stove. Fig. 9 shows a finished core for the larger component.

Moulding and Casting

These castings were made in a two-part mould and were gated into each of the rings on both sides of the castings at the parting line. A blind riser was cut at each gate and risers were also cut at the highest point on each ring and risers were also placed on the lugs of the smaller castings. These lugs were formed by side cores and the handle on the larger casting was also cored out. A pouring temperature of 730-740 deg. C. was finally adopted as being the lowest that would produce a casting free from mis-runs. This temperature range was strictly adhered to owing to the risk of hot cracks occurring when higher temperatures were used.

Heat-treatment and Inspection

To minimise sagging during heat-treatment and distortion during quenching, the castings were suspended from the heat-treatment cage from one end. This method was successful. Although very little trouble was experienced each casting was checked with a dummy projectile.

INTRICATE GRAVITY DIE CASTINGS

Domestic-sink units

Originally a sink unit with a draining board either side of the sink bowl was cast in sand in an aluminium base, magnesium-zinc alloy to replace a unit pressed in stainless-steel sheet. With the prospect of increasing production, a die was constructed. Following the success of this die a variety of dies for single-draining-board

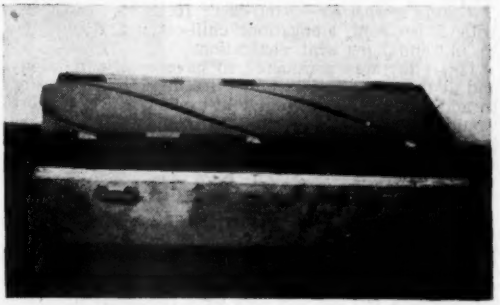


FIG. 7.—BLADES AND STRIPPING PLATE WITHDRAWN FOR REMOVAL OF THE CORE.

Some Notable Aluminium-alloy Castings

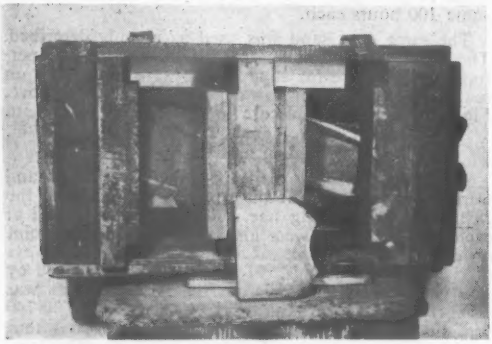


FIG. 8.—PARTLY STRICKLED CORE FOR THE HELICAL-RIBBED CASTING.

sinks and one unit comprising a single-draining-board sink and wash-tub were constructed. Changing from sand to die-casting involved a number of factors. In the first place, the original alloy, although providing an excellent finish, was too hot-short to be considered as suitable material for producing a die casting, size 63 in. x 21 in., nowhere thicker than $\frac{5}{16}$ in. and containing a bowl 19 in. x 15 in. x 8 in. deep.

Choice of Alloy

The most suitable alloy which could be chosen for such a casting was BS 2L33 which is produced to the following specification:—

Chemical Composition.—Cu, 0.1 per cent. max.; Si, 10.0 to 13.0 per cent.; Fe, 0.6 per cent. max.; Mn, 0.5 per cent. max.; Ti, 0.2 per cent. max.; and Pb, and Zn, 0.1 per cent. max. (each).

Tensile Properties.—Sand-cast: 10.5 tons per sq. in.; with 5 per cent. elongation; chill-cast: 12.0 tons per sq. in.; and 7 per cent. elongation.

This alloy was considered to have sufficient fluidity and at the same time complete freedom from cracking. In addition, it was obvious that castings of this nature would distort on being removed from the die and the ductility of the alloy permitted the castings to be re-set in the cold without damage.

Die Construction

Involved in the change was the problem of die distortion. The die had to accommodate a casting 63 in. long which was poured at a temperature of 800 deg. C. at the start of a day's production. Two courses were open for adoption but the first dies were produced on traditional lines. Fig. 11 shows the double-draining-board die opened for extraction of the casting. The base of this die consisted of three 30 in. x 38 in. x 4 in. deep grey-iron castings $\frac{1}{4}$ in. thick and these were bolted to three 6 in. x 3 in. steel channels running longitudinally. The die side facing the camera (top side of the sink) was built up from three box-form castings, approximately $\frac{1}{4}$ in. thick with flanges 9 in. wide, bolted to each other and to the base. Fig. 12 shows the form of the impression and the position of the risers and gates. The back of the die (the bottom side of the sink) consisted of two similar castings with flanges 13 in. wide. The die side was located by means of a key-way and slide but the weight was taken on rollers so arranged that the die side was raised very slightly from the base as it was withdrawn. A pneumatic ram was fitted to open and close the die, operated by a conveniently-placed foot valve.

Normally, the casting was withdrawn from the fixed-die side along with the moving side and four drifts were passed through this side to eject the casting. These drifts were located, two at each end, at the top and bottom of the end risers so as not to mark the castings. They were replaced by dummy pins during casting. After several trials had been made, pouring the casting from either or both ends with the die horizontal, it was evident that the die would have to be tilted and pneumatic rams were used for this purpose also. The two tilting rams may be seen in the illustration. Even with the die tilted there was still a tendency for the casting to misrun on the end remote from the gate. This end of the die, therefore, was heavily lagged with asbestos wool

FIG. 9.—FINISHED CORE FOR THE LOWER COMPONENT SHOWN IN FIG. 4.

on both sides. A further fault became apparent after production was under way. Slight oxide inclusions on the gated end, trapped by the riffles on the draining board, were spoiling the appearance of the finished article. This defect was associated with overheating of the die in this region and an air blast directed on both sides of the ingate fortunately provided all the necessary heat-extraction to clear up this trouble.

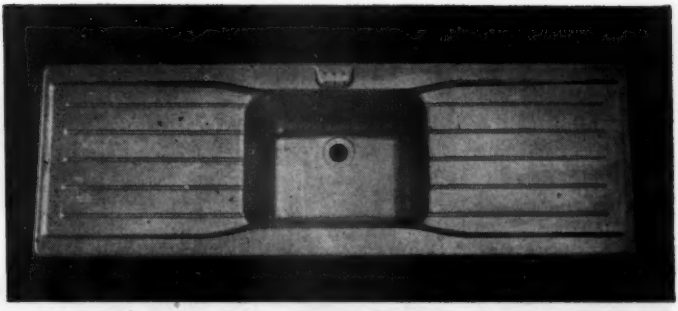


FIG. 10.—DOUBLE-DRAINING-BOARD TYPE OF SINK UNIT, GRAVITY DIE-CAST IN BS 2L33 ALLOY.

Metal Preparation

The alloy was melted either in crucible furnaces or, when the demand for metal from the foundry was sufficiently great, an oil-fired open-hearth furnace was used. The effect of modification on the shrinkage characteristics of the alloy was mentioned earlier in the Paper. If untreated metal were used, small shrinkage cavities occurred on the back of the bowl and along the flange on the lowest edge of the sink as cast. Furthermore, this shrinkage could not be overcome by suitable adjustment of the thickness of die-coating in the affected region. On the other hand, appreciable quantities of sodium metal, whilst producing the necessary modification of the alloy, generally stripped the coating from the impression. Finally, a suitable balance was struck between too little and too much sodium by the use of pre-modified ingot of consistent quality and reliance on the residual sodium after re-melting to produce the required modification. In production, at least 60 per cent. re-melt has been included in the charges without reducing the state of modification below the required level.

FIG. 11.—SINK-UNIT DIE OPENED FOR WITHDRAWAL OF THE CASTING.

Production

The die was thinly coated on the side corresponding to the top side of the sink with a proprietary mixture of finely-divided refractory oxides to produce a fine finish. The surface of the other die side was coated fairly thickly with a proprietary whitening-sodium-silicate wash.

At the start of a day's production pouring was carried out at 800 deg. C. Although the die was preheated before casting, a number of castings had to be made before the pouring temperature could be reduced. When the die reached a steady working level, the pouring temperature could be reduced to 720 deg. C. About 80 castings per shift were obtained from this die. The castings were generally distorted on removal from the die and were roughly flattened in the foundry. After fettling they were finally set with a rawhide mallet.

Two dies were made on the same principle for sink units with single draining-boards. With slight modification in casting technique, these were equally successful. They measured 42 in. x 21 in. with a bowl of the same dimensions as before, namely, 19 in. x 15 in. x 8 in. deep. However, the dies all suffered in some degree from the defect that had been anticipated, namely, cracks produced by the tremen-

Some Notable Aluminium-alloy Castings

FIG. 12.—IMPRESSION, GATES AND RISERS OF THE SINK-UNIT DIE.

dous thermal stresses. Two further single-draining-board sink units of similar dimensions and a further sink-and-wash-tub unit have been produced. This latter consisted of two castings: a sink and draining-board measuring 47 in. x 24¼ in. with a bowl 21 in. x 17¼ in. x 9 in. deep and a tub casting 25 in. x 24¼ in. with a bowl 21 in. x 17¼ in. x 14 in. deep. All these castings were made with a nominal metal thickness of ⅜ in.

When these dies were put in hand, the principle on which they were designed admitted severe distortion of the die and, instead of attempting to make the dies rigid to counter this, the die sides were made flexible so that they could be sprung together and held by the latches. Instead of the usual box-form castings, the die sides were built up from grey-iron castings 1¼ in. thick and these were bolted to a welded framework of 6 in. × 3 in. steel channel sections. In production, these dies have behaved very well. Apart from the advantage of reduced size and greater ease of working, the heat input required to keep them at a suitable working temperature is much reduced and these dies do not require lagging although the air blast is still a necessary feature.

Aircraft Rudder Pedal

The die for this casting was made as an experiment in the early days of the development of DTD 300 alloy gravity die castings. The casting was successfully produced in sand to replace a built-up steel component and it was considered that the technique employed for its production could be applied in the die with very little change. Fig. 13 shows the finished casting, which measures 17¼ in. long × 6 in. wide; the stirrups are 8 in. broad. The overall thickness of the webs and flanges is 0.15 in.; the barrel is 0.21 in. to 0.23 in. thick; and the stirrup is 0.6 in. × 0.4 in. thick. The finished weight is only 4 lb.; the as-cast weight being 13¼ lb.

The die is shown in Fig. 14. Internal form is given to the casting by two main cores; one is withdrawn into the base of the die and the other (seen on the right-hand side of the die) is lifted clear of the casting. The impression, gate and risers are cut in the two die sides and the barrel, the flanged arms and stirrup are formed by five cores each side of which is withdrawn through the die side. Provision is made for tilting the die.

Melting and degassing procedure was the same as for the sand castings previously described. The metal was maintained in bale-out type holding furnaces under a flux cover until it was required, when the flux cover was removed completely. It was not found practical partially to remove the flux cover before each casting was made. In point of fact, if the metal was brought to the required casting temperature and used at once, comparatively little oxidation was experienced.

Die Preparation and Pouring

The die was coated with a proprietary whitening sodium-silicate wash to produce a rougher surface than would normally be expected from a die casting. A

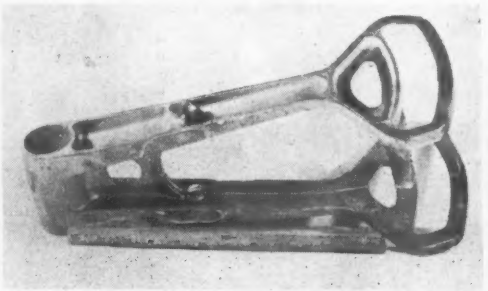


FIG. 13.—RUDDER PEDAL, GRAVITY DIE-CAST IN DTD (DTD 300 ALLOY.)

fine surface finish must take second place to soundness and freedom from cracking with alloys of this type. At the commencement of the pour the die was tilted (so that the metal flowed uphill from the gate at the stirrup) and was lowered to a horizontal position just before pouring was completed. Pouring temperatures in the range 730-760 deg. C. were found suitable and had to be strictly adhered to so as to avoid producing either cracked or mis-run casting.

Immediately pouring ceased, the cores forming the stirrup and the core pins forming the barrel on both sides of the die were withdrawn, in that order. Next, the smaller cores forming the stirrup were promptly withdrawn, followed by the four cores (two each side) forming the flanges on the arms. After a short pause, the bottom and top cores were withdrawn and finally, after a further waiting period, the casting was removed from the die. This sequence was adopted to reduce contraction stresses to a minimum. Waiting periods between operations were necessary because the alloy has a long freezing range and, prematurely, though the casting may appear to have solidified, it may still be in a pasty state and extremely susceptible to cracking when handled.

These castings do not present much of a problem in heat-treatment and much of the distortion which might occur during quenching is eliminated by the tie-bar between the stirrups.

Visual inspection by the chalk test reveals the greater part of the trouble associated with this casting, namely, fine cracks on the stirrup flange. Five shots cover the radiographic technique and, in spite of the nature of the casting, production running into tens of thousands of castings has been obtained with a very high proportion of good castings.

(To be continued.)

FIG. 14.—RUDDER-PEDAL DIE; GENERAL CONSTRUCTION. POSITION OF GATES AND RISERS MAY BE SEEN ON THE CASTING SHOWN ON THE LEFT.

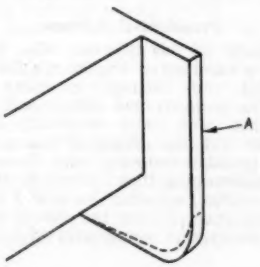
Wasters Due to Blacking

By "Coroner"

The blacking of dry sand moulds prior to storing can be accomplished either by means of a swab or spray. When compressed air is available, the latter method is to be preferred, as the blackwash can be distributed more evenly over the face of the mould. Whichever method be adopted, however, care must be exercised that excessive blacking does not collect in any part of the mould and thus make the job unsuitable for its purpose. Flanges which are thin in relation to their depth occasionally turn out defective from this cause, especially if situated near the bottom of a fairly complicated mould which has a number of straight vertical sides down which a certain portion of the blackwash sprayed on to the surface of the mould can run.

Fig. 1 shows a portion of a complicated cylinder-block casting in which the flange *A* was desired as shown by the full lines, but which on being cast was as shown by the dotted line, due to the lodgment of a quantity of the blackwash sprayed on to the mould. Much of this could have been removed by the moulder prior to sending the mould to the stove, but due to the depth of the flange from the joint of the mould and also its narrowness, this accumulation was not observed, with the result that an otherwise good casting was scrapped, or at best left for salvage by building up by welding.

FIG. 1.



Institute of British Foundrymen

South African Branch General Meeting

The twelfth general meeting of the South African Branch of the Institute of British Foundrymen was held in conjunction with the annual dinner, a function which took place at the Victoria Hotel, Johannesburg. The company numbered about 80. It was reported that the membership of the branch stood at 279, comprising 82 members, 122 associate members, 21 associates and 54 subscribing firms. For both functions, Mr. H. Teubes, the branch president, was in the chair, and in the course of a Valedictory Address said that during his year of office there had been sent for the first time a Paper to the annual conference of the Institute. Also, the branch had received a visit from Mr. Noel Newman, the president-elect of the Institute. He announced that through the generosity of Colonel Guy, a gold medal had been provided and would be awarded annually to the member who was deemed to have given the most meritorious service. At one of the best attended meetings of the year, Mr. Oliver Smalley, O.B.E., gave a brilliant Paper on "Design as Influenced by Foundry Practice," and the chairman took this as a theme for the major part of his address.

Election of Officers

As president:—Mr. W. C. Simpson.
As senior vice-president:—Mr. S. Jane.
As junior vice-president:—Mr. J. J. Marais.
As members of council:—Mr. H. Hughes, Mr. G. Godfrey, Mr. A. Guest and Mr. H. G. Goynes.

Presentations.—Mr. Teubes then presented Mr. K. L. Futter with a commendation certificate for his Paper on "Repetition Pattern-making." A second presentation was that of a portable typewriter to Mr. A. G. Thompson, editor of "The Engineer and Foundryman," who has since arrived in this country, where he is to reside permanently. Book prizes were awarded to two students, Mr. E. C. Goodeson and Mr. R. Stofford, who headed the list of successes in the N.T.C.I. examinations. Mr. Teubes then asked Mr. Simpson to take over the chair.

Presidential Address

In the course of his address, Mr. Simpson said he had been a member of the branch for many years and had read and listened to many presidential addresses. The majority had been based on two subjects. They had been either technically instructive or they had dealt with the subject of encouraging young men to the foundry industry—and once having got them there, maintaining their interest in the trade. It was the latter subject on which he would like to speak, because it was realised that the future of any trade depended on the type of young man who was attracted to its ranks; and that attraction depended to a great extent on the prospects the future held and on the status to which these aspirants could attain.

A youth who left school and entered the engineering trade, who had any ambition at all, would in due course become a certificated engineer—truly a very high honour and a goal worth striving for. To use a common expression, once he "got his ticket," he enjoyed the privileges and opportunities that such a certificate merited.

If there was a similar certificate for foundrymen—a certificate recognised by all industries and showing all and sundry that the foundryman had the practical and theoretical knowledge of his trade—this would, he thought, to a great extent supply the necessary incentive for youths to enter the foundry trade.

Instead of the young foundryman making a more or less aimless study of metals, metallurgy, etc.—he might become efficient at one, and know little of the other—he could have a set examination, just as the engineers had. The examinations for engineers covered law, power plant, elementary electrotechnics, driven machinery and mechanical appliances, and strength of materials. The foundrymen, on the other hand, could have examinations to test their knowledge of law, metals and metallurgy, administration and costing, practical foundry knowledge, pattern-making and casting design. He personally thought this step should be taken. A syllabus for foundrymen could be drawn up after an exchange of views with other associations which held examinations and issued certificates to successful members. South Africa was growing fast and vigorously, and the foundry industry was going to be called upon to perform bigger and more difficult jobs than in the past. Therefore it should be prepared to meet this challenge to its skill and to let the allied branches of the engineering trade have the sure knowledge that their castings were being made by men who were proud of their jobs.

Mineral Wealth

COLONEL GUY said South Africa, despite her present difficulties, had a very great future, for the country was quite undeveloped and possessed all the minerals which were required for the metal industry. It was a most desirable country containing every known base mineral. Those minerals should be exported without delay to improve the dollar position, and every South African should go about his tasks in the realisation that the prosperity of the country depended on hard work.

MR. F. C. WILLIAMS said it was an annual pleasure for him to convey to the branch the congratulations of S.E.I.F.S.A. on the outstanding success achieved by the branch. He considered that the branch had done more to bring the foundry industry on to modern lines than anything else in the country. There was evidence to show that ideas and techniques dealt with in

(*Continued on page* 318, *Col.* 1.)

Synthetic Resins in the Foundry

Some Recent Developments in Core Practice

By K. S. Meakin, M.A.

The properties of synthetic resins have been known to foundry metallurgists for some years past. In the role of adhesives, their qualities of strength, durability and water-resistance are firmly established and have proved particularly valuable to the maker of wooden patterns: as core-binders their use over a period of several years has given promising results which should now be assessed in relation to the performances offered by conventional binders.

Sand core-binders must breakdown at low temperatures and the choice of suitable materials is for the most part limited to organic substances. Starch, methyl cellulose, sulphite waste liquor have all been employed with varying degrees of success, but probably the most generally used binders are compounds of linseed oil and mineral oil or molasses. Linseed oil has indeed been commonly accepted as essential for many types of cores and only the scarcity and high price of this material in recent years has diverted attention to other types of binder. The main outcome of this more general approach to the subject has been the investigation of synthetic resins which have shown several valuable characteristics as binders. Their increasing use is now justified on their own merits (especially when used in conjunction with high-frequency heating) and is no longer based exclusively upon the need for a readily available alternative material.

Required Qualities of a Core-binder

Any binder for general use must be economic in the quantities required and easily be available. Linseed oil, like other goods imported from the Argentine, has been subject to continual increases in price in recent years. Production has been restricted and, apart from this measure, limitation of expenditure in hard currency areas has militated against the securing of large enough supplies. Quantities of linseed oil consumed in this country as core-binders have, nevertheless, increased from about 3,200 tons in 1946 to well over 5,000 tons in 1948. The United States is now growing more linseed than Argentina and prices in Buenos Aires are being undercut by Canadian producers[1]. There is hope for larger and more economic supplies in the future though this is not reflected in current prices.

Mechanical Properties

In the core shop, satisfactory green strength is normally required in a good binder and this is easily obtainable if a cereal binder be used with linseed oil. A short drying time is also desirable, both as a fuel-saving measure (since July, 1947, the price of coke has increased by 15 per cent. and fuel oil by 41 per cent.) and to accelerate output. Small cores, *e.g.*, the A.F.S. Standard cores, 2 in. diam., 2 in. high and weighing about 170 gm., made with linseed oil, require heating for over an hour at about 250 deg. C., and the development of an alternative binder enabling drying to be carried out at a lower temperature or in a much shorter time represents an undoubted advance.

Dry-compression strength requirements usually vary from about 150 to 1,000 lb. per sq. in., according to the metal employed and the dimensions of the castings; this range is well within the capabilities of linseed-oil binders. If "blown" castings are to be avoided, the core must also be compounded of materials which allow free passage to gases evolved when the metal is poured. Linseed oil has been shown to possess the required permeability as a binder. Finally, as metal cools it must be allowed to contract otherwise cracks will result. A corollary of this factor is that cores must breakdown at a sufficiently low temperature; linseed-oil binders do not invariably accommodate this contraction in all kinds of casting and a material having a lower breakdown temperature would offer an advantage in this direction. The quality of breaking-down at a suitably low temperature is necessary for a further reason, *i.e.*, in order that cores may subsequently be removed without difficulty—ideally, as a free-flowing powder. Unfortunately cores bonded with linseed oil sometimes need considerable vibration and drilling to assist removal, their knock-out properties are not always of the highest order.

Properties of Resins as Core-binders

The performances of phenol-formaldehyde, melamine-formaldehyde and urea-formaldehyde resins have all been investigated for core binding and the U.F. resin appears the most promising. It is very much less costly than the others, which can offer few compensating advantages for general purposes. Before discussing in detail the characteristics of urea-resin binders and describing some typical mixings it may be of interest to assess their qualities against the required properties of a binder, as outlined briefly above.

First, U.F. resins have the advantage of being easily available at a very low relative cost—to-day they are supplied at roughly two-fifths the price of linseed oil and are in fact cheaper now than before the war. They are manufactured in this country from raw materials which are also made in Great Britain; they can be obtained for foundry purposes in any desired quantities. As far as green strength is concerned, they have a slight advantage over linseed oil but incorporation of a cereal binder is still necessary to give satisfactory results. Drying times are about 50 per cent. less than those required for linseed-oil binders, an important considera-

[1] "Times Review of Industry," January, 1949, p. 67.

Synthetic Resins in the Foundry

tion in itself, yet the advantage here with synthetic resins lies more in their potentialities than in the methods by which they are commonly used. *The drying process, during which the resin sets by chemical reaction, lends itself admirably to the use of high-frequency heating* and this development is discussed in greater detail in what follows. Resin-bonded cores exhibit excellent dry strength; controlled variation of water and binder additions enables strengths far exceeding normal requirements to be achieved. Where, for example, the addition of 1 per cent. water provides a dry strength of 150 lb. per sq. in., 2 per cent. water may give 1,000 lb. per sq. in. and 3 per cent. water 1,200 lb. per sq. in. Excessively high proportions of water must however be avoided or the mixture may be too sticky and therefore difficult to remove from the core-box.

Knock-out Characteristics

In knock-out properties, resin-bonded cores offer a particular advantage over cores in which conventional binders are used. This characteristic is especially valuable when intricate castings are being made. It should be emphasised also that these outstanding breakdown properties enable cores with higher dry-strengths to be used and the figures 150 to 1,000 lb. per sq. in. given for linseed-oil bonded cores do not therefore apply to resin-bonded cores. Moreover, the resin breaks down at a lower temperature than linseed oil and there is thus less danger of cracked castings following upon imperfect collapse of cores after pouring of the metal. Unsatisfactory breakdown can also cause hot-tearing, for instance, in castings having cored cavities which are not able to contract sufficiently by virtue of the non-collapse of the core on cooling; even when no visible damage is produced there may be residual stresses and distortions which are avoided when the cores have really satisfactory knock-out properties. This consideration is of greater importance when cast steel or iron is poured, for shrinkage must then be allowed to progress over a greater range of temperature than is needed for lower-melting-point metals. Hot-tearing is, of course, often a result of heavy or uneven ramming during core-making, but it is less likely to occur when synthetic resins are used, for the cores then disintegrate at lower temperatures.

Further Characteristics of U.F. Binders

The principal requirements of a satisfactory core-binder and the extent to which it is fulfilled by linseed oil and by synthetic resins have already been discussed. Other characteristics of resin binders nevertheless exercise an important influence on their use in the foundry.

Urea-formaldehyde resin is a thermo-setting plastic material. It sets irreversibly under the application of heat and does not soften when further heat is applied. This setting is a condensation reaction and is therefore fundamentally different from that of linseed oil which is largely an oxidation process requiring the presence of air and a much longer time for its completion. Urea-formaldehyde is also far more reactive to heat than is linseed oil and so lends itself admirably to the use of special processes for accelerated drying. During the drying of a resin-bonded sand core, moreover, it has been found that the binder tends to migrate towards the surface of the core and so produces smooth hard surfaces which impart an execellent finish to the castings. Freedom from burned-in sand involves less machining and a much lower proportion of rejects. The centres of the cores are softer and this favours quick collapse when the metal is poured; supplementary means of core removal are not needed.

Resin-bonded cores have also proved valuable for the making of phosphor-bronze castings. Conventional binders often cause "finning" in such castings whereas U.F. resins, less likely to crack before or after being placed in the mould, afford some protection against this defective finish. As an inhibitor for mould reaction, U.F. resins offer an important advantage when aluminium alloys rich in magnesium are being cast.

Mosts of the difficulties inseparable from the application, in production processes, of a relatively new product have now been overcome. One problem, however, has so far defied solution; in the words of a speaker at the recent Leamington Spa Conference (organised by the Steel Castings Division of the British Iron and Steel Research Association) it is "the ancient and fish-like smell" of a decomposing U.F. resin. Addition of colophony, pine-resin oil and molasses has been essayed, but the aromatic substances which might have served to mask this smell have been found to distil off at temperatures lower than those used for pouring. Carefully executed schemes of ventilation have so far proved the only effective means of circumventing this difficulty. It may also be mentioned that the smell of decomposing linseed oil is by no means inoffensive.

Production Processes and Mixings

As a urea-formaldehyde resin for core binding, "Resolite" 288, a proprietary brand manufactured by the Author's firm, was used in a number of mixings. This product consists of a liquid resin of approximately 50 per cent. solids content and a urea powder which is added separately during mixing. It may be of interest to follow a typical batch through the processes involved in making a core:—

Mixture A:—

100 parts Southport silica sand (free from clay);
1¼ parts cereal binder;
1 part "Resolite" 288 (including 15-20 per cent. "Resolite" powder);
2½ parts water.

It is usual to mix the dry ingredients first, the sand, cereal binder and "Resolite" powder being weighed into the mixer. The "Resolite" liquid and the water are then added and mixing is continued for a period of about seven minutes to provide maximum green strength. Several points of interest at this stage need

comment. First, clay sands are not suitable for use with U.F. resins: a substantial decrease in strength occurs with this material unless the proportion of resin is increased considerably. Secondly, the order of mixing is not important; the 15 to 20 per cent. powder may be added to the "Resolite" liquid resin, before transfer to the mixer, if desired. The essential value of the "Resolite" powder is that it is hygroscopic and so reduces the rate of drying-out of the mix. "Crusting over" is a common objection to the use of synthetic-resin in a mix, for sand left overnight has often been found to dry out before use. Humectants such as ammonium nitrate in 1 per cent. additions have proved useful to prevent drying-out, but for most purposes "Resolite" powder is adequate. Another important function of the urea powder is to combine with the formalin in the mix and thus obviate the smell which would otherwise be generated.

The proportion of water to be added is critical. Two and a half per cent. may be said to represent a fair average for the mixture given above. More water may produce an excessive degree of stickiness, which has already been mentioned. (Fly ash, soft soap, paraffin, pulverised silica, ethylene glycol, ground calcium carbide and fuel oil have all been suggested to reduce stickiness). Too little water may result in an unsatisfactory core in which full strength is not developed. Method of mixing, type of mixer used, quantities being mixed and atmospheric conditions prevailing at the time of mixing must all clearly influence the proportion of water needed. Fig. 1 shows a small core produced in U.S. resin-bonded sand; the core box is left quite clean.

Effect of Mixing and Drying Times

It has also been established that the duration of mixing is critical in its influence upon green strength. About 7-10 minutes is a fair average period (bearing in mind the above considerations likely to affect mixing times) and the most suitable moment for testing for strength may be defined as the "Optimum Mixing Time."

Drying times necessarily vary according to the sizes of the cores; as already mentioned, the period required at 170 to 180 deg. C. (338 to 356 deg. F.) would be little over half the time needed for drying oil-bonded cores of similar dimensions. At these temperatures, however, drying time is critical; stronger cores are obtained if the temperature be not allowed to exceed 150 deg. C. (302 deg. F.). U.F.-bonded cores do not change to a darker colour during drying, and colour cannot therefore serve as a guide to drying times. It is important to note that U.F.-bonded cores should be removed from the oven as soon as curing is complete, otherwise they will be overbaked with consequent destruction of the resin and loss of strength in the core. In this respect, phenol-formaldehyde resins have some advantage, for a rather longer drying period after the resin has "cured" may be permitted without detrimental effect. Nevertheless, it is precisely this characteristic of breaking down at relatively low temperatures which imparts to U.F.-bonded cores their excellent properties of "collapse." The effect of high temperatures combined with prolonged drying times upon the strength of cores is illustrated in the following tables reproduced by courtesy of the Northern Aluminium Company, Limited:—

FIG. 1.—SMALL CORE MADE IN U.F. RESIN-BONDED SAND.

TABLE I.—*Dry-compression strength of Cores in. lb. per sq. in. after Baking at Various Temperatures and Times.*

Drying temperatures, deg. C.	Drying time. ½ hr.	1 hr.	2 hrs.
100 ..	185, 156 } 170	129, 261 } 195	415, 191, 270 } 292
150 ..	270, 310 } 290	472, 421 } 446½	646, 510, 542 } 566
175 ..	367, 446 } 407	982, 917 } 950	845, 1,200, 732 } 926
200 ..	1,020, 950 } 985	842, 838 } 840	682, 638, 810 } 710
250 ..	405, 255 } 330	9.6, 14.3 } 11.9	6.4, 3.2, 4.8 } 4.8

Synthetic Resins in the Foundry

The above dry-compression strengths were obtained with standard A.F.S. specimens baked in a thermostatically-controlled electrically-heated oven. The green-sand mixture gave compression strengths of 1 to 1½ lb. per sq. in. and 138-151 units permeability. The results are shown graphically in Fig. 2.

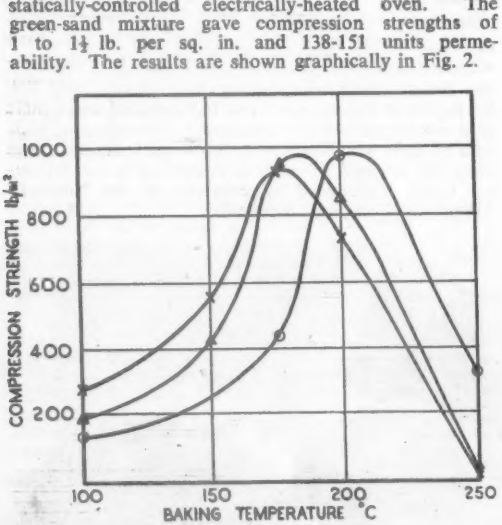


FIG. 2.—RESULTS AS IN TABLE I, SHOWN GRAPHICALLY.

Another mixture includes a small addition of paraffin to reduce stickiness:—

Mixture B:—

100 parts clay-free sand;
2 parts cereal binder;
1 part "Resolite" 288;
2½ parts water;
½ part paraffin oil.

After drying for about an hour at 170 deg. C., the above mix should provide cores giving a dry-compression strength of about 800 lb. per sq. in. Increase of the proportion of "Resolite" to 1½ parts would provide a strength of about 1,200 lb. per sq. in. Both the mixtures quoted will be found to show a green strength of 1 lb. per sq. in. or more, and 150 to 200 A.F.S. units permeability.

It cannot be too strongly emphasised that variations of proportions must be made under careful supervision. The proportion of water must be large enough to enable the cereal binder to give adequate green strength, but not enough to produce a high degree of stickiness. Reducing the proportion of "Resolite" will result in lower dry-strength and lower water-resistance, and may involve problems of sagging. Like with the duration of mixing, the proportion of water in the mix is a factor of great importance when U.F. resins are employed as core-binders.

Water-resistance

Although U.F. binders are capable of offering sufficient water-resistance for normal requirements, the more expensive phenol-formaldehyde and melamine-formaldehyde resins are superior in this respect. In Switzerland, equal proportions of U.F. and M.F. resins have been used in mixes to provide cores for heavy ferrous castings. A hardener is also sometimes incorporated to accelerate polymerisation, although this may involve a shorter usable life for the mix. One such mixture includes equal proportions of U.F. and M.F. resin in addition to an acid hardener and provides cores which can be freely handled after drying for 15 minutes at 100 deg. C. Mixtures of this type will harden without application of heat, but some drying usually is necessary to expel moisture from the core.

Special Processes and Techniques

The high degree of thermal reactivity shown by U.F. resin-bonded cores has suggested the use of various methods which would exploit fully this important property and so enable much shorter drying times to be achieved. Infra-red lamps, used for many years for drying moulds, have been employed for accelerating the drying of resin-bonded cores. In Germany, the "C" process, invented by Johannes Croning, involved the use of metal core boxes heated to 180 to 200 deg. C. for drying P.F. resin-bonded cores. The most outstanding results, however, have been effected by dielectric heating, known also as radio-frequency (R.F.) and high-frequency (H.F.) heating. H.F. heating has a number of industrial applications, including the accelerated curing of synthetic resins used as adhesives for wood. For the rapid drying of sand cores it has so far been used far more widely in America than in Great Britain.

High-frequency Heating

High frequency differs only from the normal alternating current supplied by the electricity mains in that it reverses direction far more rapidly—many millions of times a second, perhaps, instead of only fifty times. The generating of these swiftly alternating—in fact "high frequency"—impulses is the function of large valve oscillators which supply the power to two electrodes. As the current alternates between these electrodes, a field is produced in any material (provided there is a di-electric loss in the material) which lies between them. Enormous friction is generated—and therefore great heat—in the molecules of such substances, and the effect is *immediate and uniform* throughout the material. H.F. heating for any purpose, therefore, differs radically in principle from oven heating, in which the outer part of a body must be heated to a very high temperature in order

to transmit heat to the centre. A corollary of this property is that bodies containing substances which react rapidly at elevated temperatures (as for example resin-bonded sand cores) can be heated uniformly throughout their mass in a remarkably short space of time. Temperatures attained during H.F. heating are relatively low, yet an average time of 1 to 2 minutes suffices to dry standard A.F.S. sand core specimens which will subsequently give compression strengths of the order of 1,000 lb. per sq. in.

It has already been emphasised that unlike conventional oil binders, synthetic resins cure by the completion of a condensation reaction. This process involves the removal of some moisture which must be permitted to escape by means of an air gap provided between the top of the core and the electrode. Once the moisture has been removed by di-electric heating, loss of heat by radiation is greater than that being generated in the sand-mixture, and the core temperature therefore begins to fall. One important result of this sequence is that it is not possible to "over-cure" the resin-bonded core. In some mixtures it has been found desirable to include small proportions of acid catalysts so that complete polymerisation of the resin can be assured.

Mixture C:—

100 parts by weight sand;
2.5 parts by weight "Resolite" 288;
2 parts by weight cereal binder;
2.5 parts by weight water.

The above mixture was used to make standard A.F.S. compression cores which were dried by a 6-kw. generator supplied by Pye, Limited, Radio Works, Cambridge. At the end of two minutes cores were tested and the following results recorded:—

Dry-compression strength: 1,200 lb. per sq. in.
Dry tensile strength: 140 lb. per sq. in.
Dry permeability (A.F.S. number): 220.

Evolution of moisture during drying has already been mentioned, and it has been found advisable to construct the top electrode of the H.F. assembly in the form of a perforated metal sheet through which the steam can pass. A small extractor fan housed above this upper electrode draws the moisture from all the cores being dried and so prevents water from condensing and falling back upon them—a sequence which would delay the drying process.

Fig. 3 illustrates the drying of A.F.S. compression specimens; the steam extractor has been removed to reveal the perforated electrode. The space between electrodes can be increased or diminished by a simple adjustment, but the simultaneous baking of cores having different dimensions may require special measures—*e.g.*, introducing a step in one of the electrodes. Shaping the contour of the upper electrode to conform with that of the cores may also sometimes be desirable. Fig. 4 shows a group of resin-bonded cores.

H.F. heating for the drying of sand cores utilises to the full the characteristics of synthetic-resin binders and supplements them with its own particular advantages. There is obviously an enormous saving of time and increase in output. Less space is required and work can be carried out in cooler surroundings, largely free from smoke and fumes. Moreover, as lower temperatures are used for drying, cores can subsequently be handled without the use of gloves. In America, H.F. heating has been adapted successfully to production line set-ups, and great reductions in cost per unit have been claimed. Trays of cores are loaded on to feed conveyors which pass between two electrodes in baking units, each giving an output of 400 to 600 lb. of cores per hour. Adjustment of electrodes is simple, and in any case it has been found that if the spacing is set for the highest cores the smaller ones still receive adequate heating.

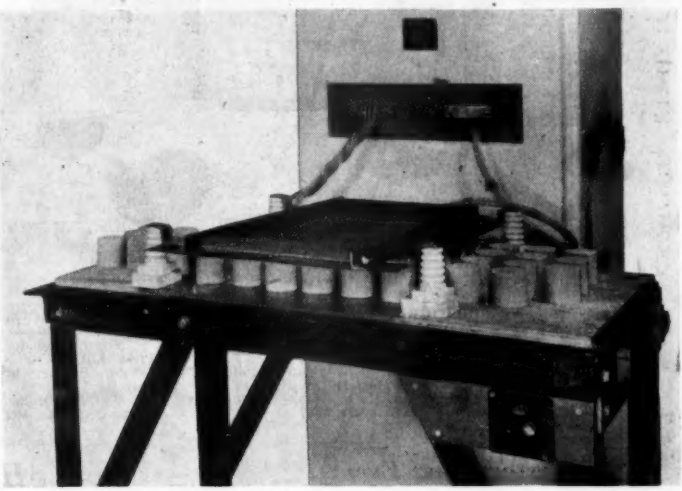


FIG. 3.—DRYING OF A.F.S. COMPRESSION SPECIMENS.

Conclusions

Synthetic resins have been found to offer exceptional advantages as core-binders, and urea-formaldehyde resins, by virtue of their low cost and the excellent knock-out properties they afford, would appear to be the most promising. They dry quickly at low oven temperatures and provide cores of good dry strength. U.F. resins disintegrate at relatively low temperatures and so eliminate much of the labour that

Synthetic Resins in the Foundry

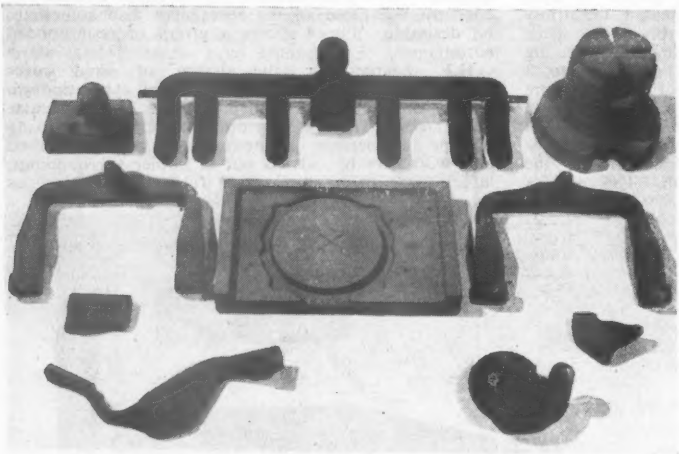


FIG. 4.—GROUP OF RESIN-BONDED CORES.

is otherwise needed to obtain clean castings; they have proved especially valuable for casting aluminium, magnesium and phosphor-bronze alloys, and are also suitable for ferrous work, particularly where metal sections are thin.

The condensation reaction, which promotes setting in a U.F. resin, provides cores which are highly reactive to heat and therefore lend themselves admirably to the use of high-frequency heating. Lower temperatures and shorter times can indeed be employed for oven-drying of resin-bonded cores, but it is probable that H.F. heating will be used increasingly to exploit fully their advantages in rapid drying.

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Forthcoming Events

SEPTEMBER 9.

Institution of Production Engineers.

West Wales Sub-section :—"Air in Industry," by C. W. Wheal, at the Technical College, Swansea, at 7.30 p.m.

SEPTEMBER 13.

Institution of Production Engineers.

Manchester Graduate section :—"Some Recent American Hydro-electric Schemes," by W. A. Hatch, at the Reynolds Hall, College of Technology, Manchester, at 7.15 p.m.

Birmingham Graduate section :—Film show ("Electronics in Industry"), at the James Watt Memorial Institute, Great Charles Street, Birmingham, at 7 p.m.

SEPTEMBER 16.

Institute of British Foundryment.

West Wales section :—"Tackle and Moulding in Loam of an Evaporated Body," by W. H. Hornby, at Landore Works, Richard Thomas & Baldwins, Limited, at 7.15 p.m.

Institution of Production Engineers.

Eastern Counties section :—"Impressions of a Tour to Canada and U.S.A.," by H. H. Dawson, at the Lecture Hall, Electric House, Ipswich, at 7.30 p.m.

SEPTEMBER 17.

West Riding of Yorkshire branch :—Visit to W. Asquith, Limited, Halifax; presidential address; S. W. Wise Prize-winning Paper, at 2.30 p.m.

House Organs

Murex Review, Vol. 1, *No.* 4.—Published by Murex, Limited, Rainham, Essex.

The main article in this issue is "The Elements Present in Aluminium Casting Alloys, with Some Notes on Methods for their Introduction," by Mr. D. C. G. Lees, of the Aluminium Development Association. It is quite a useful contribution to a subject which has not been widely publicised. There is a second article on the determination of molybdenum in ferro-molybdenum. This publication is available to our readers on writing to Rainham.

Nickel Bulletin for July.—This issue devotes a large section to subjects under the heading of heat- and corrosion-resisting alloys. Among those of interest are details of the sub-zero properties of austenitic steels and austenitic nickel-alloy steel castings. Further abstracts appear under the headings of nickel, electro-deposition, non-ferrous alloys, nickel-iron alloys, cast iron and constructional steels. Copies of the publication may be obtained free on request to The Mond Nickel Company, Limited, Sunderland House, Curzon Street, London, W.1.

New Mechanised Foundry at Stafford

W. H. Dorman & Company's Balanced Plant

Our representative was recently privileged to attend a small ceremony to mark the opening of a new mechanised foundry by W. H. Dorman & Company, Limited, ironfounders and Diesel engine manufacturers, of Stafford. The new production system caters for an output, at present, of 50 tons per day and the mechanisation has been undertaken by Augusts, Limited. Special attention has been devoted throughout to the betterment of working conditions, the provision of labour-saving machinery, wherever possible, and the installation of good lighting, ventilating and dust- and fume-removal plant. The whole project has been admirably carried out in the utilitarian sense, but a single point of criticism from the æsthetic sense might be made. The seemingly tangled mass of overhead steelwork necessary to carry such an abundance of mechanised equipment is an eyesore and a dust-trap which no amount of tidiness and good housekeeping at floor level can mitigate. What follows is a brief account of the layout and salient features of the new foundry.

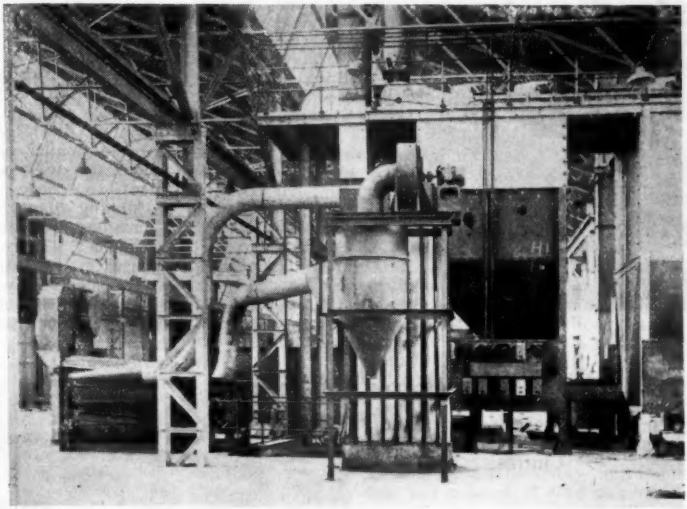

FIG. 1.—GENERAL VIEW OF THE SAND-PREPARING PLANT, WITH THE "PERMEABILITY-CONTROL UNIT" IN THE FOREGROUND.

General Layout

Under one roof, covering an area of approximately 120 by 350 ft., are housed integrated sections for both "light" and "heavy" machine moulding, some hand moulding, a fully mechanised core shop and sand plant, fettling shop, cupolas, as well as ancillary sections for mould drying, sand and coke storage, inspection, loading decks, etc. Provision is left for extensions to the pattern stores and for some existing loose-pattern moulding. The whole structure is contained on a reinforced-concrete raft with no general sand floor, but instead individual pits where these are specially required. Viewing the ground plan, the mechanised moulding section runs lengthwise in the centre bay, with the sand plant at one end and the fettling section at the other. The cupolas are located centrally on one of the longer sides and on the opposite side is the core shop. Between the cupolas and the mechanised moulding section is the part of the floor devoted to loose-pattern work and large moulding jobs.

Special Features

Both the small moulding machines and those for medium-weight castings (the latter incorporating Sandslinger and turn-over plant) are placed in line and served by overhead sand supply. The sand plant (Fig. 1), however, is divided to produce two system sands simultaneously according to the type of work in the different sections. These are delivered to individual machine hoppers by belt conveyors and the obtuse-angle ploughs shown in Fig. 2. From the two knock-out units (one of the electrical-vibrating type for light castings and one stationary for heavy castings) the sand passes on an underground conveyor past an over-band magnetic separator and is elevated to a rotary screen. During the screening it is treated from a "permeability-control unit" (Fig. 1) to reduce silt and fines, and it then passes to a more orthodox system of hoppers, mills and conveying units. The sand supply to the Sandslinger plant is from a rotary hopper, shown in Fig. 3. Likewise, some of the larger moulding machines are supplied from individual belt feeders.

Another somewhat unusual feature is the diagonal siting of coring and mould-assembly conveyors between

New Mechanised Foundry at Stafford

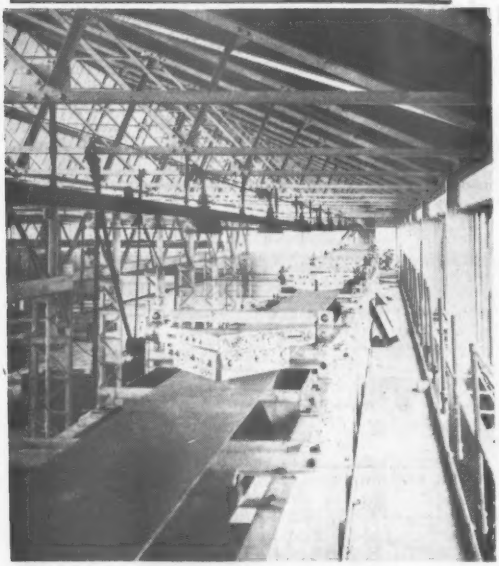

FIG. 2.—SAND DISTRIBUTION SYSTEM TO THE MOULDING MACHINE HOPPER USING SELECTIVE DOUBLE PLOUGHS AND CHUTES.

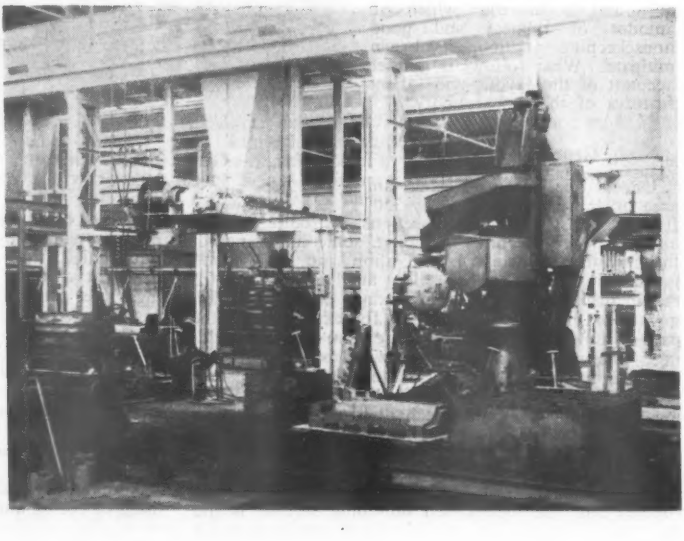

FIG. 3.—SAND-FEED SYSTEM FOR THE LARGER MOULDING MACHINE AND THE SANDSLINGER.

the machines and the main pouring loop; extra feed-conveyor length is thus provided for a given space between machines and loop.

Individual Plant

Of moulding machines there is wide variety according to size, ranging from pin-lift types of "Brittania" and "Stone-Wallwork" for small work, medium machines by "Stone-Wallwork" and "British Moulding Machines" and larger units of the "Osborn" and "Pneulec" roll-over and "British Moulding Machines" pin-lift types. One pendulum conveyor is used for carrying moulding boxes, castings and cores for the mechanised systems; a second is incorporated in the core shop. Other core-shop equipment includes an "Acme" vertical stove, a large core-drawing machine, two sand driers (one by "Fordath"), a core blower and sundry subsidiary items.

In the fettling shop, which incorporates an inspection bay and the loading deck, there is a shot-blast room for the larger castings and a Wheelabrator plant for the smaller ones. The usual variety of grinders, pneumatic tools and the like make up the complement.

Melting plant is comprised of two 2-ton-per-hour "Jackman" cupolas, one 4-ton "Titan" and a 6-ton "Pneulec." There are two batteries of bogie-type drying stoves for large moulds and cores with fining arrangements between. Adequate storage bunkers are strategically situated for sand, coke, ganister and similar raw materials.

(*Continued on page* 318, *foot of col.* 2.)

Experiences with Ethyl Silicate in the Foundry*

Emphasis on Mould Dressings

By D. F. B. Tedds†

(*Continued from page* 286.)

APPENDIX

The three solutions used in the various procedures outlined in this paper are:—(1) Water Solution "A"; (2) Spirit Solution "B"; and (3) Spirit Solution "C."

Preparation

Water Solution "A".—To 500 ml. of ethyl silicate is added 100 ml. of 0.5 per cent. HCl. The small amount of acid acts as a catalyst, or accelerates the hydrolysis. The mixture is shaken or passed through an emulsifying machine when after a period of 15 to 30 mins. heat is gradually generated until the solution reaches a temperature of approximately 50 deg. C. and becomes homogeneous, and also opaque. As soon as this stage has been reached, the remainder of the water (1,400 ml.) is added and the whole is thoroughly mixed. The solution is cooled to room temperature and is then ready for use.

Spirit Solution "B".—To 500 ml. ethyl silicate is added 100 ml. 0.5 per cent. HCl and 400 ml. alcohol (methylated spirits). This mixture is shaken or passed through an emulsifying machine, usually for a shorter period than that required for the water solution. When hydrolysis has occurred a further addition of one litre of alcohol is made, the solution being then ready for use.

Spirit Solution "C".—A third solution which finds applications and here is called a "spirit solution" is actually a mixture of equal parts of ethyl silicate, alcohol, and water. To 750 ml. ethyl silicate is added 250 ml. alcohol and 75 ml. 5 per cent. HCl. Initial hydrolysis is carried out as previously, followed by the addition of 500 ml. alcohol and 675 ml. water to complete the dilution. The solution is allowed to cool to room temperature before use.

These compositions are summarised in the accompanying table:—

	Composition.		
	Water solution "A."	Spirit solution "B."	Spirit solution "C."
Ethyl silicate ..	500 ml.	500 ml.	750 ml.
Dilute hydrochloric Acid	100 ml. (0.5 per cent.)	100 ml. (0.5 per cent.)	75 ml. (5 per cent.)
Alcohol	—	1,400 ml.	750 ml.
Water	1,400 ml.	—	675 ml.
Approx. cost per pint	11d.	1s. 3d.	1s. 7d.

*Presented at the Cheltenham Conference of the Institute of British Foundrymen.

†The Author is foundry metallurgist, The Bristol Aeroplane Company, Limited.

DISCUSSION

MR. A. W. BRACE said the Author had explained that by spraying the surface of magnesium cores with ethyl silicate solution followed by skin drying, a good hard surface was produced which was quite satisfactory. Why then was it necessary later to add ammonia bifluoride to the mixture? He also asked about labour costs, and said that another point on which he would like clarification was in relation to spray solution "C." Why was it that it contained such a comparatively high water content? He was sure the Paper was of interest both to ferrous and non-ferrous foundrymen, and thought it would be found to be particularly useful where metal erosion was a problem.

MR. TEDDS replied that they did not find anything peculiar in the introduction of ammonia bifluoride for spraying magnesium cores, and could not agree that it might be left out. As to labour costs, they had not reached the stage of actual production, but he did visualise that later they might employ a number of girls on mass producing the cores. With regard to the core being left in the box after the dilution period, this operation lasted about five minutes, and it was spray-solutioned at the half-way stage, *i.e.*, in the green state. A certain amount of spirit was introduced into solution "C" to give it a harder gel. The aluminium castings produced gave a very satisfactory finish, but he would not advocate this method of core-making for foundry production.

Collapsibility of Cores

MR. BOOTH asked Mr. Tedds if he could give more information about the collapsibility of the cores. Would the spray mixture referred to, be applicable to other materials? Would it, for example, be suitable for iron and steel, where sand adhesion was a problem?

MR. TEDDS replied that of all the materials they tried for increasing the strength of cores, plaster-of-Paris was the best, but they could not make it up to the strength they would have liked. They managed to make it a little stronger by coating the outside of the core with the spirit solution, but the cores were still on the weak side. With regard to the sand adhesion, the surface of the mould and of the core probably required some sort of coating. Maybe this clinging of the sand to the actual metal would be stopped by the water solution "A," incorporating a filler, *e.g.*, sillimanite, zirconia, etc.

Ethyl Silicate in the Foundry

MR. A. TIPPER said bearing on this question of binding sand with silicate, he asked Mr. Tedds why such a high proportion of ethyl silicate only produced a very low bond strength. There was 15 per cent. of ethyl silicate in this mixture. Was it partly due to the fact that he had added 20 per cent. of fines? Why was he adding fines? A core sand bonded with 5 to 7 per cent. sodium silicate gave a very strong hard core.

Supposing he took the Bedford sand and made up a mixture with a similar proportion—say 10 per cent. —or sodium silicate, what sort of results would he get then? If they were going to use ethyl silicate as a bond for cores, how could it compare with ordinary bonding material when used under normal conditions? Lack of permeability appeared to be one of the chief problems. One of the most interesting applications of ethyl silicate was for surface coatings, but he thought a considerable amount remained to be done to determine the most satisfactory way of obtaining a uniform coating. He asked Mr. Tedds if he had any suggestions to make there? He had seen the plant at Bristol and he was quite sure Mr. Tedds could give a great deal more information about the whole process of casting if anyone wished to go further into it.

MR. TEDDS said he agreed that the proportion of silicate was very high. Just why they did not get the strength, he did not know. When he tried the 90 Bedford mixture with 10 fines, it was very weak and would hardly stand its own weight. By increasing the fines he was able to strengthen the material. They had to concentrate the 80/20 mixture to keep the fines hard at a suitable minimum owing to the poor permeability when higher percentages were used. The normal type of bonding material was as yet a long way from being replaced by ethyl silicate. Most of the coatings he had tried had been applied by means of a spray gun. When the spirit solution was applied without any filler incorporated, an even coating was possible, but with filler additions, he agreed this was still a problem owing to the build-up in corners, etc.

Core Dressings

MR. KEEBLE said in view of what he had reported in the Paper, would Mr. Tedds favour the use of an ethyl silicate mould or core dressing to minimise the trouble of friable surfaces which arose from premature drying out sometimes experienced with synthetic sands? It was indicated that water solution "A" contained a certain amount of hydrochloric acid. Had Mr. Tedds experienced trouble when using metal core boxes and was the coating of vaseline given primarily to facilitate stripping or to prevent corrosion? In the Paper it was stated that where refractory coatings were desired the water solution should be used. Yet later it was said that a spirit solution was employed. Would Mr. Tedds enlarge on these statements?

In the aluminium gravity die-casting world, sodium silicate was extensively used as the binder in die-coating mixtures. When making castings in aluminium-silicon (2L33) alloys, they were involved in an attack on the coating apparently between the sodium in the metal (necessary for the conditions of modification) and sodium silicate in the coating. He (Mr. Keeble) had not studied the chemistry of the matter, but did Mr. Tedds think that using ethyl silicate in place of sodium silicate as the binder would reduce or eliminate this attack, and if he did, would it introduce other complications?

MR. TEDDS replied that with regard to the use of an ethyl silicate spray there was a tendency to harden up the surfaces of moulds and cores. It was purely on the synthetic type of sand that they tried it out, and it certainly prevented friability. Vaseline was used definitely for ease of stripping, but it would, of course, also have the effect of preventing the possibility of corrosion when using metal core boxes. They coated the oven walls with solution "B," using alumina as the filler, to get a very hard refractory skin, and it was quite satisfactory at 1,000 deg. C. The furnace had now been stripped down again, but he considered that was the best coating for furnaces. When it came to coating cores, however, he thought the water solution was the best when a filler was added, since the gel produced was more flexible and not prone to crazing. He had little or no experience with the coating of dies, and considered that the coating might strip off straight away on a hot die. It was also doubtful whether ethyl silicate would minimise or reduce the attack of 2L33.

Applicability to Cast Iron

MR. C. A. PAYNE said in the past his firm had been quite content to work their castings to get within $\frac{1}{32}$ of an inch. It was a matter of thousandths in the case of aluminium. He asked for guidance as to how this method could be applied to cast iron, when cored components, approximately 12 in. by 15 in., had to be made.

MR. TEDDS said that the major problem was to strengthen up the core, and much greater strength of core would certainly be required for cast iron. He would not like the job of casting components of the size quoted by Mr. Payne to within fine dimensions.

MR. PAYNE said that they would all be very happy were Mr. Tedds able to make such a core. Was it possible to increase the strength of the mould to 800 deg. C. to give the necessary increase in strength?

MR. TEDDS said it was possible to take the moulds up to 1,000 deg. C., and they were much harder than experienced in ordinary foundry practice. They might be able to produce such a core, and if they got together on this, they should be able to work out something afterwards.

MR. L. RAMSDEN said that with modern precision moulding it was possible to go quite a long way towards closer limits in the method of administration, on their moulding machines. By this means they found they had been able to work to very close limits. With regard to the cores he suggested that they would get far more accuracy combined with collapsibility by working the changes on the sands to two grain sizes and by using a finer sand with a little colloidal clay.

They could go a long way by spraying, to get harder skins, provided they did not use too much of the spray mixture.

DR. SCHWEITZER said they had had most successful results in a great number of castings when using ethyl silicate, but occasionally it had the disadvantage of giving a mould which showed reaction between such a metal as cerium and the moulding material.

MR. TEDDS said that he had had no experience at all of casting cerium into moulds.

DR. SCHWEITZER said that when using alumina alone as a mould material no inner facing at all was necessary. They avoided any surface silica and used no fluxing. They assembled round steel rods which could be withdrawn, and so had been able to achieve very hard or soft moulds as desired.

MR. TEDDS suggested that the cause of the reaction might be due to excess ethyl silicate in the moulds which could be extracted by vibrating the moulds, under satisfactory conditions.

THE CHAIRMAN (Mr. N. P. Newman, President) said that though they had had a generous time allowance for discussion, he believed there was still room for a good deal of research and experiment as to the actual advantage of the method. He thanked Mr. Tedds very warmly for his opening remarks and also for the extremely intelligent way in which he had dealt with the discussion.

News in Brief

GREAT BRITAIN has been granted $17,006,000 to buy aluminium and copper from Canada under the Marshall plan.

IRON AND STEEL PRODUCTION in the Anglo-American zone of Germany reached a new post-war record during July. The month's totals were 624,216 tons of pig-iron, 776,795 tons of steel ingots, and 529,580 tons of hot-rolled products.

MR. E. H. LEVER, chairman and managing director of Richard Thomas & Baldwins, Limited, stated last week that the sum of approximately £750,000 was being spent by the company on new developments at Panteg steelworks.

TWO APPRENTICES of A. C. Wickman, Limited, Mr. L. B. Rutter and Mr. L. K. Lord, have obtained a degree of B.Sc. (Mechanical Engineering), under the scholarship founded by the firm in 1943 and tenable at Birmingham University.

FURTHER MECHANISATION of iron-ore mining in North Lincolnshire, which will include American machinery to modernise work at the ore face and reduce rail haulage, is expected to result in output being doubled within 12 months.

AMONG classes of goods to be freed from price control on September 26 are domestic hollow-ware (aluminium, stainless steel, copper, brass and plated), domestic heaters and appliances, safes, builders' hardware, ironmongery, nails and bakery machinery.

THE ANNUAL CONVENTION of the American Institute of Mining and Metallurgical Engineers is to be held in Columbus, Ohio, from September 25 to October 1. Visits to the Battelle Memorial Institute and the Ohio State University are to be included, as well as a number of manufacturing plants.

A RECENT MEETING of the Victorian division of the Institute of Australian Foundrymen took the form of a technical film night. A collection of some of the latest sound films related to foundry practice was made available through the courtesy of the Steel Company of Australia (Pty), Limited, and the Electrolytic Zinc Company (Australia), Pty, Limited.

THE MACHINE-TOOL CONCERN of Dean, Smith & Grace, Limited, Keighley, is holding an "open week" from September 19 to 24. During this period visitors will be welcome to inspect the works, the methods of production, plant and organisation of the undertaking. Invitations to visit the works have already been accepted by the Mayor and members of Keighley Town Council and Keighley Trades Council.

A REFRESHER COURSE for works and plant engineers, comprising 26 addresses by specialists, has been organised by the South-Western Region of the Incorporated Plant Engineers at Bristol College of Technology. There is to be one two-hour evening session each week; one hour for the address and the second hour for discussion. Full details are obtainable from the Secretary to the Course, 12-14, Apsley Road, Clifton, Bristol, 8.

ON AUGUST 23, members of the Council of the London Branch of the Institute of British Foundrymen visited Western Foundries, Southall, at the invitation of the directors of the parent company, Le Grand, Sutcliff & Gell, Limited. The occasion was the completion of the alterations and extensions to the existing foundry buildings. Every effort has been made to increase productivity per unit area and improve conditions for personnel.

AMONG GERMAN PLANT about to be allocated between member nations of the Inter-Allied Reparations Agency, and for which the United Kingdom is bidding, are the steel-making, wire, foundry and forge plants at Klöckner Werk A.G., Düsseldorfer Werk, Düsseldorf, and Ruhrstahl A.G., Annener Gustahlwerk, Witten-Annen. Anyone wishing to acquire equipment from these factories should notify the Ministry of Supply (G.5e), Shell Mex House, Strand, London, W.C.2, by September 15.

REFERRING TO THE VISIT to America of the British steelfoundry productivity team, Mr. F. N. Lloyd, chairman and managing director of F. H. Lloyd & Company, Limited, stated at the company's annual meeting that it has been found that, although substantially higher wages were paid in America, and the level of productivity in American steelfoundries was correspondingly higher, the Americans had not, except on specialised products, any advantage over the British industry in overall levels of manufacturing costs.

South African Branch Annual Meeting

(*Continued from page* 306.)

Papers presented to the branch and in the discussions had been put into practice. The branch's activities had resulted in the creation of a foundry industry which was almost entirely foreign to that which had existed 20 years previously.

He did not share the pessimism displayed by many South Africans regarding the country's present difficulties. When one surveyed the position rationally, it emerged that whatever happened the country could not do without the skill of the South African engineering industry. It was his belief that the country was now getting from the industry the efficiency it demanded.

Opportunity for Expansion

MR. DAVIDSON said he too had watched the branch grow over a period of many years and had seen improvements and corrections introduced to make the branch what it was at present. He had been taken to the first annual meeting of the branch by his father, who was one of the founders of the branch. An excellent indication of the phenomenal growth of the organisation was to be found in the fact that only five men had been at the head of affairs to start the branch off, whereas the membership was now approaching the 300 mark.

The foundry industry in South Africa seemed to be very favourably placed for continued expansion, and if full advantage was taken of the opportunities which now presented themselves there was every reason to expect that the industry would expand with remarkable speed. In their early days, South African foundries had been concerned mainly with routine plant maintenance for the mines, but conditions had changed and it was now necessary for the foundries to deal with the manufacture of capital goods.

For real efficiency in the industry it was important that the manufacturer should know the true cost of each production process. Britain and America could not at present meet the tremendous demand for their products, but the day would come when those countries would enter the field in a vigorously competitive spirit. Mr. Davidson felt that the South African foundry industry should put its house in order without delay so that it would be able to stand up against future competition, and he wanted to impress upon foundrymen the fact that it was essential for them to take greater interest in the costing side of their business. It was the accountant's job to work out the true cost of the job and to find out whether the job could be done on a competitive basis. It was essential for the good of the industry that the cost should be fair to the consumer and to the manufacturer.

Apprenticeship Training

DR. ROWE said that at the technical college, he was on close contact with the man-power problem facing the industry. They had experienced great difficulty in endeavouring to impress upon young lads the fact that fine openings existed in the foundry industry. The youngsters showed a preference for the job of the fitter and turner and for electrical work. They were not very interested in boiler-making and blacksmithing, for instance, because such trades involved what they considered to be far too much hard work. In the proposed intensive training scheme for apprentices, outlined by the Commission on Technical and Vocational Education, steps would be taken to ensure a balanced supply of apprentices to all trades, and it was hoped that the present position would be rectified before long.

Congratulating the president on his election, MR. TONGE expressed the opinion that as far as costing was concerned, he had read a great many books on that subject and had yet to find two authorities who were in full agreement.

Association of Bronze and Brass Founders

The report of the president of the Association of Bronze and Brass Founders at the last general meeting, as reported in our issue of May 5, included the following:—

Die-casting

> Not all members were interested in die-casting, but those who were would be pleased to know that their interests, *vis-à-vis* the Ministry of Supply Advisory Committee, were being well taken care of by Mr. Max Horton. The Ministry has shown a tendency to wish to acquire knowledge which die-casters had rightly considered to be trade secrets. This tendency has been resisted, tactfully but firmly.

We are asked to announce that the Association of Bronze and Brass Founders wishes to withdraw the last two sentences of the above extract, as they do not give a true picture of the present position. The Association wishes to emphasise the excellent spirit of co-operation which the Advisory Committee (Die Castings) is in fact fostering between Service departments and trade associations with such mutually valuable results.

New Mechanised Foundry at Stafford

(*Continued from page* 314.)

The foundry produces cored and some uncored castings of varying intricacy, weighing from a few ounces to four tons, and it will be realised from the foregoing that a really practical combination of balanced mechanisation of light and heavy sections along with a modicum of hand-moulded work has been achieved. It promises to give high production per unit floor space without losing the "elasticity" of output which is so necessary in a works of this type.

Some Notes on Off-set*

By J. Shebar

Despite the wide differences in type of plant, classes of work, methods used and metals melted in the various foundries, which make up our highly complex industry, at least one thing common to all foundries is the incidence of a certain proportion of scrap in the castings produced. A cause of waster castings in practically every branch of the industry is a defect known as "off-set" or "miss-match." This is most commonly encountered where moulds are made in steel or iron moulding boxes, or in snap-flasks, and it is with this class of work that these notes are mainly concerned.

Causes of Miss-matched Castings

The possible causes of this defect are more varied than might at first be imagined, and some idea of the reason can often be formed by the percentage of finished castings off the same pattern which are off-set. Where the number of castings suffering this defect is very small in proportion to the number which are good, the reason or reasons for such a fault will most likely be entirely different from that when all, or a very large proportion, of the castings are off-set.

It is hardly to be understood how, in these times, work could be put in hand when errors or inaccuracies in the pattern plant and moulding tackle could cause every casting produced to be off-set, although it is quite understandable that such errors may occur before trial castings are made. Slight discrepancies in the positioning of the patterns on the pattern plates, or errors in the positioning of pinholes or lugs should be discovered and rectified before a pattern is used for regular production purposes, and no doubt this elementary precaution is universally observed. However, a careful watch should be kept on all items of plant both for wear and possible movement.

Pattern Inaccuracies

Pattern plates are often mounted on machines which ram moulds by jarring or jolting, and frequently the plates are subject to vibration to facilitate the stripping of the moulds. Under these circumstances the patterns may be moved or loosened, or the pins used to locate the box or flask may become loose, with the result that the accuracy of the plant is impaired, and further castings made in moulds from this equipment may be off-set until the plant is restored to its original condition. Whilst patterns are usually mounted in such a way that there is little chance of movement occurring, the possibility is always present, and it seems to be the exception rather than the rule for pins to be fitted with a safety device to prevent them from working loose.

Pattern-plate and Moulding-box Pins and Holes

The pins affixed to pattern plates, and the pins used for closing boxes, which may be of the loose variety or affixed to one part of the box, are liable to wear; the same applies to the holes in which these pins locate. In normal practice, the pins on the pattern plant are a few thousandths under-size, and those used for closing have a slightly greater tolerance. Provided these tolerances are checked periodically and the necessary steps are taken before wear becomes excessive, trouble should be avoided; on the other hand, when wear is allowed to develop unchecked, off-set castings will be almost inevitably the result. Close supervision is needed all the time where loose pins are in use; a few brief examples will serve to illustrate the need for this. Where only the moulding, but not subsequent closing and clamping (if done), is the province of the machine moulder, he may work with loose or under-size pins to speed up the rate of moulding, or to save the time taken to place a box in position. Where, due to obvious faults, the box is not a good fit over the pins, a machine moulder may be able still to use the box if his pins be under-size or loose. In this way he may be evading the necessity for him to remove the box unused and to replace it with another. In closing, also, it is not unknown for condemned or unauthorised pins which are badly worn or under-size to be used—"for the quickest"—or even for the boxes to be closed without the use of pins at all. The same remarks apply to clamping, and in this latter case, a much more serious effect may result compared with that caused in other stages of the moulding operations, due to the possibility of the box parts being struck with a hammer. If, on the other hand, proper use is made of the pins during clamping, where this is a separate operation, faults which may have been caused by previous operations may be discovered or rectified before casting takes place.

Snap-flask Practice

Where moulds are made in bands and snap-flasks, badly-fitting bands are not an uncommon cause of off-set. When a band has to be forced into the flask, it will almost inevitably spring out of shape again as soon as the flask is unfastened, with a resultant movement in whichever part of the mould is contained therein. Once again an off-set casting may result. Moulds made by the "band-and-board" method are especially prone to this defect, particularly when the patterns are mounted on a flat plate, and the mould joint is therefore also flat. An irregular joint line is a great help in tending to prevent movement of the mould parts after the flask is removed. Movement of the two parts when the joint is flat can be caused in many ways, one of which is a distorted carrying plate or board. Accidental knocking or kicking of moulds before weights are placed in position can account for odd cases of off-set. When moulds of this type are placed on the floor, where vibration from heavy moulding or other machinery can be transmitted through the floor, quite a large number of moulds may be moved slightly by such vibrations and off-set castings will again result.

When cores are used, these, too, may be a source of trouble resulting in off-set castings. Cores which are

*Entry for a Short Paper Competition organised by the East Midlands Branch of the Institute of British Foundrymen.

Some Notes on Off-set

slightly over-size, and which prevent the cope part of a mould from going down correctly, can result in the mould being pushed slightly sideways. When otherwise similar cores, embodying only a slight dimensional difference are in use in the same section of a foundry, a moulder may inadvertently use incorrect cores, which may result in off-set castings. In fairness to the core-maker, it should be noted that if cores are dried on incorrectly designed carriers, they may be wrong in size due to a fault which is not the responsibility of the core-maker; similarly, the core may be correct in itself, but the pattern-maker may have allowed an insufficiently large print to take the core. Apart from these instances, cores may be supplied to the moulder which are over-size, as a result of such things as the core box halves being improperly assembled before the core is rammed. It will thus be seen that, where off-set castings are found, consideration of the sand cores should not be forgotten.

It is hoped that these notes, which do not pretend to have touched more than the fringe of the problem of off-set castings, will have shown that the causes of this defect may be many and varied, but, in practically every case (unlike some of our castings defects), preventable.

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of increases in raw material prices and national insurance, and advances in wage rates. There has not been any corresponding advance in selling prices, and present indications are that it will be necessary to effect further economies in manufacturing costs during the present year, as our profit volume is made by operating on a large turnover, with a relatively narrow margin of profit. . . . We have not, so far, experienced any recession such as has been felt in certain sections of the engineering industry.

Atlas Steel Foundry & Engineering Company, Limited, Armadale, West Lothian:—The board recommends the issue, out of the company's reserves, of 18,750 bonus shares of £1 each, fully paid, in the ratio of one share for every £3 ordinary stock (*i.e.*, for every 12 units of stock of 5s. each) held as at August 29, each share to be converted into four stock units of 5s. each. The issue will bring the company's issued capital up to £75,000, the amount of the authorised capital.

Allied Ironfounders, Limited:—At an extra-ordinary general meeting on August 24, the special resolutions proposed for the adoption of new articles, for increasing the ordinary capital by £900,000, for the capitalisation of certain reserves, and the issue as fully paid of 696,560 ordinary shares of £1 each to the shareholders in the proportion of two such shares for every five ordinary shares held were approved.

Fodens, Limited:—In order to finance the much larger turnover the directors have decided to make a further issue of ordinary shares. The authorised capital of the company is £550,000 in £1 ordinary shares of which £345,825 have been issued.

Company News

The paragraphs below have been extracted from statements circulated to shareholders, speeches made at annual meetings, and other announcements.

Metal Industries, Limited (SIR J. DONALD POLLOCK):—Our electrical companies have a satisfactory volume of work on hand and I think we may look forward to another successful year in this section. Our mechanical engineering companies have entered a development period and they may not be able to repeat their higher level of profits in the current year. The volume of production during 1949-50 will be qualified by design modifications now in progress, by increased emphasis on development work to extend the range of manufactures for the future, and by an increasingly competitive market for some products. We hope that any diminution of profit in this section will be temporary and we are confident that we are wise to accept some modification now in the interests of longer term prospects. In the metal division the shipbreaking and marine salvage section is expected to have a satisfactory year and the probability is that the profits here will be up to those of the year just completed.

George Kent, Limited, engineers, of Luton (MR. P. W. KENT):—The company's increase in profit is due to the expansion of turnover—the past year's being the highest in the company's history at approximately £2,500,000—combined with a very marked rise in productivity per man-hour. It would have been agreeable if we had been able to take advantage of this position by increasing the dividend distribution, but we have given our undertaking not to do so in compliance with the Chancellor's request. Furthermore, the trading situation is becoming more difficult, and the tendency must be for a reduction in price; and at the same time, in two of the three main divisions of our products, industrial instruments and steering gears for vehicles, there is still a pressure upon us, from customers' requirements, to increase our capacity, and that will involve some capital expenditure.

Fairbairn Lawson Combe Barbour, Limited, textile engineers, ironfounders, etc., of Leeds:—As soon as market conditions permit, the directors propose to issue 1,997,132 1s. ordinary shares at par in the proportion of one new share for each share held and 400,000 new £1 cumulative preference. It is also proposed to issue in due course £500,000 new first mortgage debenture stock. Consideration is also to be given at the appropriate time, to the capitalisation of part of the reserves so as to bring the issued ordinary capital more into line with the capital employed in the business. The proposed changes in the company's capital structure are to be submitted to the various classes of shareholder at meetings to be held at Leeds on September 20.

F. H. Lloyd & Company, Limited, steelfounders, of Wednesbury, Staffs (MR. F. N. LLOYD):—We have been able to maintain our progress in spite of the extra costs which we have had to face, in the shape

(*Continued in col.* 1.)

Correspondence

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

To the Editor of the FOUNDRY TRADE JOURNAL

MALLEABLE IRON ANNEALING

SIR,—The Paper "Influence of Heating Rate in Malleable Iron Annealing," by S. W. Palmer, in the August 4 issue of the FOUNDRY TRADE JOURNAL, contains much of interest, and the work is evidently being carefully done. The following comments will apply only to the portion of the work dealing with blackheart malleable iron, since there is no production of whiteheart malleable iron in the United States or Canada.

The data given in Table III are valuable, as too little attention has been paid to the effects of mould type and condition on the annealing rate and the mechanical properties of malleable iron. Further work in this direction would seem indicated. It might be mentioned that the average chemical compositions of the test-bars given in Table III (assuming them to be of the white iron before annealing) are similar to those used commercially in North America, except that the sulphur and phosphorus contents are low, being respectively 0.05 to 0.09 and 0.14 to 0.18 per cent. in North American cold-charge air furnace practice. Furthermore, the annealing cycles used in general North American practice are similar to the "A" and "B" anneals of Mr. Palmer, except that the rate of heating to first-stage soaking temperature would fall somewhere between the "A" and "B" rates. Since the lower phosphorus content of Mr. Palmer's irons would presumably tend to produce higher elongation figures, it would seem worth noting that all of his figures for elongation are about one-third less than those obtained commercially in North America for similar conditions. This is not to suggest that higher elongation *per se* is better or desirable, but there is a distinct difference in properties, and the explanation is not evident. The higher phosphorus content of North American irons should work in the opposite direction, and the difference in test-bar size (0.564 against 0.625 in. dia.) would not seem important.

Although it is well established that smaller, more numerous temper-carbon nodules lead to more rapid first stage, and, especially, second stage (pearlitic) graphitisation, the quantitative effects of nodule number alone on mechanical properties have not been clearly delineated in the literature. The data in Table III give some indication in this direction, but when comparison is made with the microstructures shown of the centres of the bars, it is evident that much of the difference in properties must be weighed by the effect of the presence of pearlite in the rapidly-heated bars. Since the effect of nodule number on mechanical properties requires clarification, it would be appreciated if Mr. Palmer could give further data which would correlate nodule number and mechanical properties of bars which are completely ferritic in matrix microstructure and of similar or identical melt metallurgy and chemistry.

Work published in the United States, and unpublished work of the writer, show that when the nodule number is very greatly increased (by a factor of 100 to 500 times) as by pre-quenching, mechanical properties suffer, ultimate and yield strengths being lower by about one-tenth, and elongation decreasing from values of 16 to 18 per cent. to values of 5 to 6 per cent.

Schneidewind and Reese, in a Paper given before the American Foundrymen's Society in St. Louis last May, discussed the effect of rate of heating on the time necessary for first stage annealing, and the writer, in discussion, used their data to show that minimum total annealing times, and therefore the most efficient use of a given annealing equipment, resulted from using the fastest heating rates commercially practicable, which in present equipment are 40 to 60 deg. C. per hour. This makes doubly important the determination of the effect of nodule number alone on mechanical properties. Probably nodule shape and density will also have to be considered.—Yours, etc.,

J. E. REHDER,
Foundry engineer.
Department of Mines and Resources
(Mines, Forests and Scientific Services Branch),
Bureau of Mines,
Physical Metallurgy Division,
568, Booth Street, Ottawa, Ontario.
August 22, 1949.

Productivity Team for U.S.A.

Internal-combustion Engineers

A team of British internal-combustion engineers will leave England on October 7 to study production methods in the U.S.A. The visit has been arranged by the Anglo-American Council on Productivity. The leader of the team is Mr. J. R. Bergne-Coupland, works manager of Ruston & Hornsby, Limited, Lincoln, and with him in the supervisory group are Mr. W. Torkington, assistant works manager, Mirrlees, Bickerton & Day, Limited, Stockport; Mr. L. de Gebert, methods investigation engineer, Davey Paxman & Company, Limited, Colchester; and Mr. P. L. W. Shevelton, production engineer, R. A. Lister & Company, Limited, Dursley, Glos.

The technical group of the team consists of Mr. M. A. Plint, chief designer, Stuart Turner, Limited; Mr. J. Calverley, draughtsman, Peter Brotherhood, Limited, Peterborough; Mr. H. Silberstein, designer, and Mr. T. Smith, inspector, J. & H. Maclaren, Limited, Leeds. The members of the workshop group of the team are Mr. A. E. Sendall, ganger tester, Ruston & Hornsby, Limited; Mr. E. Sleigh, turner, Mirrlees, Bickerton & Day, Limited; Mr. R. J. Ford, turner, R. A. Lister & Company, Limited; Mr. J. S. Nice, toolroom engineer, Davey Paxman & Company, Limited; and Mr. F. Rogers, maintenance fitter, Brush Electrical Engineering Company, Limited, Loughborough.

The secretary of the team will be Mr. H. Cowper, technical officer, British Internal Combustion Engine Manufacturers' Association.

Raw Material Markets

Iron and Steel

The need for an early and substantial increase in blast-furnace outputs is clearly manifest. Requirements of the melting shops and the foundries have been on a reduced scale during the past two months, and this has tended to conceal the deficiencies in production. But bigger tonnages of both basic and foundry grades of pig-iron are now called for and as quickly as possible additional blast furnaces will have to be put into operation. It is reported that another new stack at Consett is rapidly approaching completion and may soon be ready for action.

Both from near-Continental ports and also from more distant sources, arrivals of steel semis continue on a most impressive scale. These, of course, are liable to be curtailed at any moment by official ukase, but for the present re-rollers are very well placed in the matter of raw materials. Home-produced slabs are plentiful, but sheet mills are using substantial tonnages of foreign sheet bars to supplement home deliveries. Small billets are also in active request, although larger sizes are now more freely obtainable.

The outstanding feature of the finished-steel trade is the enormous unsatisfied demand for light steel sheets. In this respect mill capacity at home and abroad is hopelessly overburdened. The plate mills, too, are working under heavy pressure and there are numerous export inquiries in circulation. On the other hand, reasonable delivery dates can now be indicated for the normal range of sections. Rail mills are heavily committed to the end of the year (in some cases into 1950), and there is an extensive demand for tube strip and all classes of wire products.

Non-ferrous Metals

It was reported that Ministry of Supply officials visited The Hague recently in order to confer with Dutch experts regarding the situation created by the freeing of the market in New York. It is also understood that conversations have taken place in London with trade interests, presumably those who before control was clamped down on tin were handling purchases and sales of Straits tin. London, before the war, was the world's greatest centre of trading in tin, and the wealth of accumulated experience available must be very great. The whole situation is confused and uncertain and, at the time of writing, the Ministry is still out of the market so far as sales of Straits tin to the United States are concerned. In the meanwhile, the situation in New York is developing and expanding under the revivifying influence of freedom from control, and it is reported that a meeting of the Metals Group of the Commodity Exchange was held to examine the possibility of resuming trading in the futures. It is now some eight years since operations in tin on the Commodity Exchange were suspended, and it is certain to take time to start again after such a lapse, but with the London market closed, and nothing definite known about any reopening, New York has an excellent chance to establish itself in a strong position as the world's chief centre in tin.

Prices on both sides of the Atlantic are firm, and last week saw a partial advance to 10½ cents in zinc values in the U.S.A. An increase in the U.K. quotation took effect on Monday, the price of good ordinary brand zinc being raised by £2 15s. per ton to £66 5s. The last change in the price of zinc had been on July 26, when there was an increase of £2 15s. per ton.

The British Bureau of Non-ferrous Metal Statistics reports that consumption of copper in the U.K. during July dropped to 34,629 tons, from 41,210 tons in June. The split of the former figure is 22,667 tons of virgin and 11,962 tons of secondary metal. In June our consumption was 27,404 tons of virgin and 13,806 tons of scrap. Usage of copper for the first seven months came to 187,303 tons of virgin and 103,208 tons of scrap. As might be expected, stocks of copper in this country went up during July, the total of 142,084 tons, comparing with 127,025 tons at the end of June.

Obituary

MR. JAMES TWEEDALE, formerly a director and works manager of Thomas Robinson & Son, Limited, engineers and ironfounders, of Rochdale, died recently, at the age of 78.

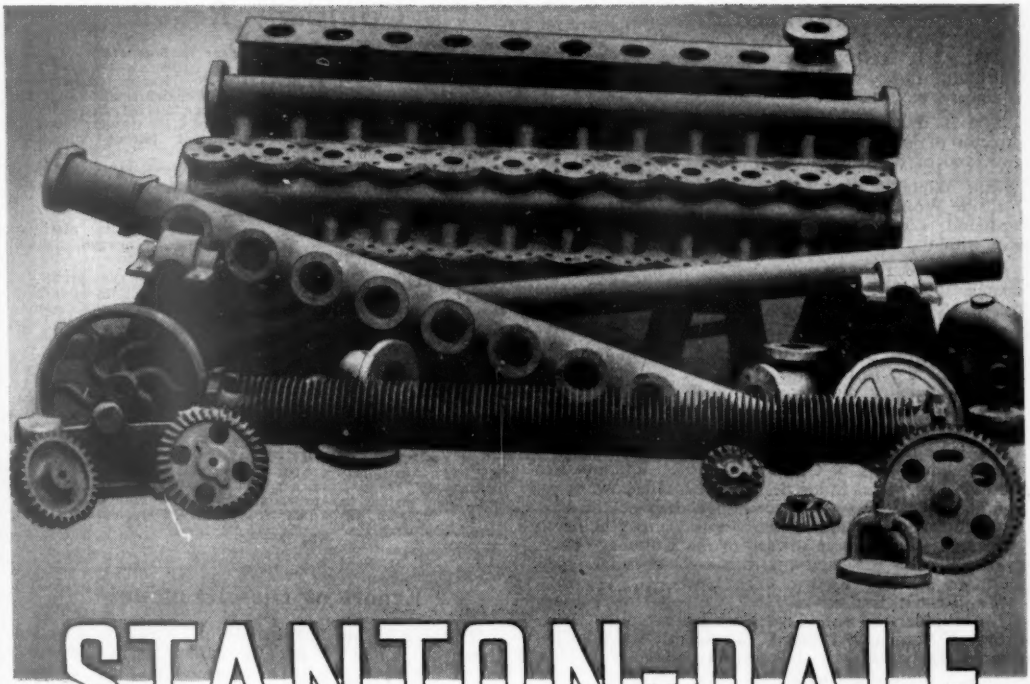
MR. WILLIAM D. MARTIN, who has died suddenly in Dundee, was for 30 years a lecturer in marine engineering at Dundee Technical College. He was for 37 years hon. secretary and treasurer of the Dundee Institute of Engineers.

COL. W. A. SEAMAN, a grandson of Mr. Edward Tozer, one of the founders of Steel, Peech & Tozer, has died at the age of 59. He joined the company on his demobilisation after the 1914-18 war and later held an appointment on the sales staff of the United Steel Companies, Limited.

Scottish Pig-iron Supplies

Pronounced shortage of high-phosphorus pig-iron is affecting the Scottish light-castings industry; delivered tonnages are so promptly consumed that there is little margin for stock purposes. Engineering founders and jobbing founders are not so hard pressed, as low- and medium-phosphorus qualities are in better supply, but the production of foundry pig-iron in general is little more than equal to current requirements.* Foundry coke supplies are being well maintained, and allocations for the summer period are found to be sufficient to meet all demands.

*At the Midland Ironfounders' Association annual meeting last week the reverse was said to be true of Great Britain over-all, the lower phosphorus iron being in shorter supply despite the easier position as a whole.—EDITOR.



STANTON-DALE

REFINED PIG IRON

Designed to meet the demands of high quality castings, which are, strength, machineability, and resistance to wear.

All these can be secured by using Stanton-Dale Refined Pig Iron in your cupolas.

The above illustration shows a group of castings made by Messrs. Goodbrand & Co. Ltd., Stalybridge, Cheshire.

PROMPT DELIVERY

THE STANTON IRONWORKS COMPANY LIMITED NEAR NOTTINGHAM

Personal

MR. A. L. RINTOUL has retired from the board of Fairbairn Lawson Combe Barbour, Limited, textile engineers, etc., of Leeds.

MR. T. H. THORNEYCROFT has been appointed a director of William Baird & Company, Limited, Glasgow, and of Bairds & Scottish Steel, Limited, Glasgow.

MR. WILLIAM WADDELL, chief draughtsman at the Hallside Works, Cambuslang, of the Steel Company of Scotland, Limited, has retired after 43½ years' service with the company.

SIR RICHARD SOUTHWELL, professor of engineering science at Oxford University from 1929 to 1942, is to receive the honorary degree of Doctor of Science from the University of Bristol.

SIR JOHN M. DUNCANSON, commercial and technical director of the British Iron and Steel Federation, has been appointed a director of Lithgows, Limited, shipbuilders, of Port Glasgow.

MR. J. R. TWADDLE, chairman and managing director of John Allan & Company (Glenpark), Limited, metal refiners, etc., of Glasgow, has been appointed to the board of Metal Industries, Limited, Glasgow.

MR. GEORGE LYNCH, national president of the Iron & Steel Trades Confederation, who is shortly going to Nigeria as trade union adviser to the Colonial Office, has received a presentation from colleagues in recognition of his service.

MR. JOSEPH LYDEN, who has worked for 52 years as a moulder in the Clydebank shipyard of John Brown & Company, Limited, has recently retired. He entered the yard as a 14-year-old lad to follow a family tradition. His seven older brothers were moulders, and several nephews are engaged on the same job.

MR. R. H. GUMMER, a director of International Combustion Limited, is leaving for South Africa on September 15. During his tour, Mr. Gummer will be concerned with the progress of the company's numerous contracts in the Union, as well as local manufacturing activities in Johannesburg and Durban. He will also participate in the activities of International Combustion Africa, Limited, in the launching of their extensive new foundries and engineering shops at Port Elizabeth. His address in South Africa will be, Lopulco House, Cor. Simmonds and Webber Streets, Selby, Johannesburg.

Wills

HELM, W. H., retired ironfounder, of Padiham, Lancs £55,102

WARNER, ROBERT, bell founder, of Frinton-on-Sea, Essex, a former Master of the Worshipful Company of Founders £20,145
[After personal bequests he left residue to the company on the following conditions: (1) Capital to found a fellowship or fellowships in metallurgical research as applied to foundry practice; and (2) "A cup of hypocras shall be drunk at court dinner of company on swearing-in day in October each year."]

Company Results

(Figures for previous year in brackets.)

BLAKEY'S BOOT PROTECTORS—Consolidated trading profit for year ended March 31, £157,478; depreciation, £5,918; exceptional depreciation and obsolescence, £14,551; tax, £87,078; net profit, £49,293; ordinary dividend of 22½% (same); forward, £119,548 (£83,240). Trading profit of parent company, £117,227; net profit, £35,783.

RICHARDSONS, WESTGARTH & COMPANY—Trading profit for the year ended March 31, after providing for deferred repairs, £526,290 (£484,330); depreciation, £75,704 (£72,967); taxation, £281,050 (£250,000); net profit, £169,303 (£161,981); dividend of 10% (8%, plus 2% capital distribution); to general reserve, £80,000 (£110,000); forward, £91,829 (£60,915).

FAIRBAIRN LAWSON COMBE BARBOUR—Net profit for the year ended March 31, after taxation, £136,473 (£92,253); taxation recoverable, £40,000 (nil); dividends of 100% (same) on the preferred ordinary shares and 41¼% (35%) on the ordinary shares; to general reserve, £50,000 (£234,500); dividend equalisation reserve, £25,000 (same); forward, £162,221 (£101,629).

WELLMAN SMITH OWEN ENGINEERING CORPORATION—Net profit for the year ended March 31, £164,224 (£83,684) after charging £24,517 (£19,931) for depreciation, £130,620 (£70,617) for income tax and £43,200 (£25,794) for profits tax; surplus tax provisions from earlier years, £13,000 (nil); available, £248,418 (£158,281); to reserves, £75,000 (£65,000); pensions, £50,000 (nil); final dividend of 7½%, making 12½% (same), plus a special cash bonus of 5%, tax free (nil) from surplus tax provisions; combined balance forward, £90,427 (£70,918), of which £51,137 (£47,671) relates to the parent company.

Export of Diesel Engines

Mr. Alan P. Good, chairman of British Oil Engines (Export), Limited, in an after-dinner speech, referred to the tremendous increase over the last 10 years in export of Diesel engines by the industry, and said the 1939 exports of the whole Diesel engine industry were worth £2,776,000. No details are available for the annual rate of export in 1949, but the total reached in 1948 was £16,761,000. B.O.E.X. is exporting in 1949 at the annual rate of £7,750,000. That is 45 per cent. of the figure reached by the whole British industry during 1948. Doubtless the total figure for 1949 has increased substantially, but the B.O.E.X. proportion of the national export of Diesel engines must be over one-third. Its present rate of export is 18 times in value its 1939 figure.

I.B.F. Golf Contest

With the date of the 1949 I.B.F. golf competition—September 24—drawing near, prospective entrants, who as yet have not done so, are requested to communicate with Mr. R. C. Shepherd, Redholme, Grantham Road, Waddington, Lincoln, without delay.

The competition this year is being played at Woodhall Spa, Lincs, and transport arrangements, for those who may experience difficulty in travelling to the course, will be made on request.

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Current Prices of Iron, Steel and Non-ferrous Metals

(Delivered, unless otherwise stated)

September 7, 1949

PIG-IRON

Foundry Iron.—No. 3 IRON, CLASS 2:—Middlesbrough, £10 4s.; Birmingham, £10 0s. 6d.

Low-phosphorus Iron.—Over 0.10 to 0.75 per cent. P, £11 15s. 6d., delivered Birmingham. Staffordshire blast-furnace low-phosphorus foundry iron (0.10 to 0.50 per cent. P, up to 3 per cent. Si)—North Zone, £12 2s. 6d.; South Zone, £12 5s.

Scotch Iron.—No. 3 foundry, £11 18s. 3d., d/d Grangemouth.

Cylinder and Refined Irons.—North Zone, £12 14s. 6d.; South Zone, £12 17s.

Refined Malleable.—P, 0.10 per cent. max.—North Zone, £13 4s. 6d.; South Zone, £13 7s.

Cold Blast.—South Staffs, £15 16s. 6d.

Hematite.—Si up to 2½ per cent., S & P over 0.03 to 0.05 per cent.; N.-E. Coast and N.-W. Coast of England, £11 16s. 6d.; Scotland, £12 3s.; Sheffield, £12 9s.; Birmingham, £12 15s.; Wales (Welsh iron), £11 16s. 6d.

Spiegeleisen.—20 per cent. Mn, £17 8s.

Basic Pig-iron.—£9 17s. 6d., all districts.

FERRO-ALLOYS

(Per ton unless otherwise stated, basis 2-ton lots, d/d Sheffield works.)

Ferro-silicon (6-ton lots).—20/30 per cent., £25 15s.; 40/55 per cent., £32 10s.; 70/85 per cent., £49.

Ferro-vanadium.—35/50 per cent., 15s. per lb. of V.

Ferro-molybdenum.—70/75 per cent., carbon-free, 6s. 5d. per lb. of Mo.

Ferro-titanium.—20/25 per cent., carbon-free, 1s. 3½d. lb.

Ferro-tungsten.—80/85 per cent., 7s. lb.

Tungsten Metal Powder.—98/99 per cent., 8s. lb.

Ferro-chrome.—4/8 per cent. C, £60; max. 2 per cent. C, 1s. 5d. lb.; max. 1 per cent. C, 1s. 5½d. lb.; max. 0.15 per cent. C, 1s. 6½d. lb.

Cobalt.—98/99 per cent., 12s. lb.

Metallic Chromium.—96/98 per cent., 5s. 1d. lb.

Ferro-manganese (blast-furnace).—78 per cent., £25 3s.

Metallic Manganese.—94/96 per cent., carbon-free, 1s. 9d. lb.

SEMI-FINISHED STEEL

Re-rolling Billets, Blooms and Slabs.—BASIC: Soft, u.t., £16 16s. 6d.; tested, up to 0.25 per cent. C (100-ton lots), £17 1s. 6d.; hard (0.42 to 0.60 per cent. C), £18 16s. 6d.; silico-manganese, £23 19s.; free-cutting, £20 1s. 6d. SIEMENS MARTIN ACID: Up to 0.25 per cent. C, £22 4s.; case-hardening, £23 1s. 6d.; silico-manganese, £26 6s. 6d.

Billets, Blooms and Slabs for Forging and Stamping.—Basic, soft, up to 0.25 per cent. C, £19 16s. 6d.; basic, hard, over 0.41 up to 0.60 per cent. C, £21 1s. 6d.; acid, up to 0.25 per cent. C, £23 1s. 6d.

Sheet and Tinplate Bars.—£16 16s. 6d.

FINISHED STEEL

Heavy Plates and Sections.—Plates, ship (N.-E. Coast), £20 14s. 6d.; boiler plates (N.-E. Coast), £22 2s.; chequer plates (N.-E. Coast), £22 19s. 6d.; heavy joists, sections and bars (angle basis), N.-E. Coast, £19 13s. 6d.

Small Bars, Sheets, etc.—Rounds and squares, under 3 in., untested, £22 6s.; flats, 5 in. wide and under, £22 6s.; rails, heavy, f.o.t., £19 2s. 6d.; hoop and strip, £23 1s.; black sheets, 17/20 g., £28 16s.

Alloy Steel Bars.—1-in. dia. and up: Nickel, £35 6s. 6d.; nickel-chrome, £49 18s. 6d.: nickel-chrome-molybdenum, £55 0s. 9d.

Tinplates.—I.C. cokes, 20 × 14, per box, 41s. 6d., f.o.t. makers' works.

NON-FERROUS METALS

Copper.—Electrolytic, £107 10s.; high-grade fire-refined, £107; fire-refined of not less than 99.7 per cent., £106 10s.; ditto, 99.2 per cent,, £106; black hot-rolled wire rods, £116.

Tin.—99 to under 99.75 per cent., £569; 99.75 to under 99.9 per cent., £572 10s.; min. 99.9 per cent., £577.

Zinc.—G.O.B. (foreign) (duty paid), £66 5s.; ditto (domestic), £66 5s.; "Prime Western," £66 5s.; electrolytic, £67; not less than 99.99 per cent., £68 10s.

Lead.—Good soft pig-lead (foreign) (duty paid), £87 5s.; ditto (Empire and domestic), £87 5s.; "English," £88 15s.

Zinc Sheets, etc.—Sheets, 10g. and thicker, ex works, £82 5s.; rolled zinc (boiler plates), ex works, £80 5s.; zinc oxide (Red Seal), d/d buyers' premises, £65 16s. 6d.

Other Metals.—Aluminium, ingots, £93; antimony, English, 99 per cent., £160; quicksilver, ex warehouse, £18 10s.; nickel, £224.

Brass.—Solid-drawn tubes, 19½d. per lb.; rods, drawn, 10½d.; sheets to 10 w.g., 16d.; wire, 16½d.; rolled metal, 14½d.

Copper Tubes, etc.—Solid-drawn tubes, 19½d. per lb.; wire, 144s. 9d. per cwt. basis; 20 s.w.g., — per cwt.

Gunmetal.—Ingots to L.G.2 (85/5/5/5), £77 to £90; L.G.3 (86/7/5/2), £80 to £118; G1 (88/10/2), £126 to £156 per ton, delivered.

Phosphor-bronze Ingots.—P.Bl, £126 to £170; L.P.Bl, £88 to £118 per ton.

Phosphor Bronze.—Strip, 22½d. per lb.; sheets to 10 w.g., 24½d.; wire, 24½d.; rods, 23d.; tubes, 27½d.; chill cast bars: solids, 23d., cored, 24d.; 10 per cent. phos. cop., — ; 15 per cent. phos. cop., — ; phosphor tin (5 per cent.), — . (C. CLIFFORD & SON, LIMITED.)

Nickel Silver, etc.—Ingots for raising, 1s. 4½d. per lb. (7%) to 2s. 1d. (30%); rolled metal, 3 in. to 9 in. wide, × .056, 1s. 10½d. (7%) to 2s. 7d. (30%); to 12 in. wide, × .056, 1s. 11d. to 2s. 7½d.; to 25 in. wide, × .056, 2s. 1d. to 2s. 9½d. Spoon and fork metal, unsheared, 1s. 9½d. to 2s. 5½d. Wire, 10g., in coil, 2s. 3½d. (10%) to 3s. 0½d. (30%). Special quality turning rod, 10%, 2s. 2½d.; 15%, 2s. 7d.; 18%, 2s. 11d.

Book Review

Structure and Properties of Metals (2nd edition), by R. M. Brick and Arthur Phillips. Published by McGraw-Hill Publishing Company, Limited, Aldwych House, London, W.C.2. Price 36s.

The first edition of this book by Professors Brick and Phillips appeared in 1942 and was prompted by the necessity of providing information for industrial employees and engineering students engaged in the production of war materials. Given this objective it is not to be understood that the work is of a very elementary nature, for it gives a well-balanced account of physical metallurgy from the technical point of view. The new edition is nearly twice the size of its predecessor, due chiefly to an extended treatment of the section devoted to the behaviour of steels. In fact, 200 out of 485 pages refer to the latter, and recent ideas about the transformation of austenite are dealt with at length.

The primary purpose of the book is to focus attention on the relation between the physical and mechanical properties of alloys and their corresponding microstructures. This is done systematically by reference to available phase diagrams, and the provision of more than 200 excellent photomicrographs, but the book does not claim to be a full treatise on thermal-equilibrium diagrams. The point is made that cooling conditions in technical practice seldom enable equilibrium conditions to be obtained. This is where the subject treatment is of special value to the foundry metallurgist.

The general arrangement is contained in chapters based on each metal which possesses alloys of industrial importance, *e.g.*, copper, aluminium, lead, magnesium and iron, and there is one devoted to sintered metal powders. Cast and malleable irons are not dealt with in great detail and the as-cast "nodular" irons are not described. Each chapter concludes with about 10 questions for "quiz" purposes, but references to the literature are deliberately few. The book would be particularly suitable for students of industrial metallurgy.

H.O.'N.

IN THE ITEM "New Catalogues," which appeared on page 31 of our last issue, we inadvertently gave the name of the bench core blower by British Ronceray, Limited, as "Bedford." It should have read "Redford."

AMONG RECENT ADDITIONS to the plant and equipment of the National Foundry Craft Training Centre is an epidiascope provided through the generosity of the Worshipful Company of Founders and the C.F.A. A sum of money has been set aside for the purchase of suitable text-books and other books for the use of boys while at the centre.

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NOTICE

Situations advertised under this heading are available only to applicants excepted from the Control of Engagement Order, 1947, No. 2021.

Replies to Box Numbers to be addressed to:— "Foundry Trade Journal," 49, Wellington Street, London, W.C.2.

SITUATIONS WANTED

ARC FURNACE MANAGER requires position; capable of acting as Melter-Metallurgist; willing to train further personnel; small capacity furnace only.—Box 308, FOUNDRY TRADE JOURNAL.

FOUNDRY FOREMAN, with practical experience of all non-ferrous alloys; practical moulder, with experience of complete control of foundry; could train unskilled labour, supervise machine and general layout of pattern plates, etc.—Box 332, FOUNDRY TRADE JOURNAL.

FOUNDRY MANAGER (35), desires change; ferrous, non-ferrous. First-class practical technical knowledge of pattern making, green, dry, loam moulding, metal control. Able to achieve top rate production by machine, plate, loose pattern methods, large or small foundry. Strict disciplinarian with excellent record of labour control.—Box 268, FOUNDRY TRADE JOURNAL.

FOUNDRY MANAGER; 12 years' complete control of non-ferrous foundries; sound technical and practical experience of hand and mechanical production for high quality castings; competent administrator; City and Guilds; M.I.B.F.; age 40; free October/November.—Box 320, FOUNDRY TRADE JOURNAL.

SITUATIONS VACANT

APPLICATIONS are invited for the position of WORKS MANAGER, to take charge of a small Foundry near Sheffield; qualifications required include absolute integrity, technical knowledge, sound practical experience and managerial ability; please give references, details of technical and practical experience, and state age, education and salary required.—Box 318, FOUNDRY TRADE JOURNAL.

CHARGEHAND for new fully mechanised Moulding Plant; excellent opportunity for experienced machine moulder, used to high production speeds.—Apply, stating age, salary required, and full details of experience, OAKLEY BROS., LTD., Belle Vale Foundry, Cradley, Staffs.

FOUNDRY FOREMAN required by important Engineering firm, London area, to take complete charge of Iron Foundry; capacity 150 tons a month; medium and light hand and machine moulded castings; this is an excellent opportunity for the right man and carries pension.—Write in confidence, giving age, experience, and salary required, to Box No. 235, MUNDY, GILBERT & TROMAN, 86, New Street, Birmingham

SITUATIONS VACANT—*Contd.*

EXCELLENT opportunity energetic practical FOUNDRYMAN, preferably already calling trade, sell new proposition interesting all foundries.—Box 952, FOUNDRY TRADE JOURNAL.

FOUNDRY FOREMAN (Non-Ferrous) required for London Foundry. Must be fully experienced in high class engineering work. Strict disciplinarian. Knowledge of alloys to specification essential.—Write, stating age, technical qualifications, references (copies only), full details of experience and salary required, to Box 248, FOUNDRY TRADE JOURNAL.

METALLURGIST required to control Heat Treatment in Forge Department of large enginering works. Degree preferred, but not essential. Previous experience an advantage, but consideration given to man possessing suitable background to train for this work. Age up to 30.—Address, 2483, WM. PORTEOUS & Co., Glasgow.

TECHNICAL Sales Representative required by a reputable firm of iron-founders for the Midlands area. Applicants must have engineering and previous sales experience. Preference will be given to applicants with a knowledge of modern foundry practice as applied to repetition production methods.—Replies, stating age, qualifications, salary required, etc., in confidence, to Box 282, FOUNDRY TRADE JOURNAL.

WANTED IMMEDIATELY.—Experienced moulder-trained Foreman; familiar with methods and piecework prices for Grey Iron Castings up to 10 tons; for position of ASSISTANT MANAGER in a Foundry of 100 men, near Birmingham.—Apply fully to Box 312, FOUNDRY TRADE JOURNAL.

WANTED URGENTLY.—Experienced dry sand IRON MOULDERS AND COREMAKERS; castings up to 15 tons; general engineering work, Birmingham district; piecework and output bonuses and excellent pension fund; permanencies to really skilled tradesmen.—Apply fully to Box 314, FOUNDRY TRADE JOURNAL.

BUSINESS OPPORTUNITIES

ADVERTISER, with a Grey Iron Foundry, would like a monetary interest in a small Foundry making Light Castings (Grey Iron); Midlands preferred.—Box 306, FOUNDRY TRADE JOURNAL.

BUSINESS OFFER.—Advertiser invites enquiries from Practical Foundryman willing to take up financial interest and manage small iron foundry. London district.—Box 278, FOUNDRY TRADE JOURNAL.

BUSINESSES FOR SALE

IRON and Aluminium Foundry, Sussex Coast; half share offered to practical man; £2,500; good turnover and prospect for the right man.—HALL, 9, Romney Road, Rottingdean, Sussex.

BUSINESSES FOR SALE—*Contd.*

FOR SALE.—Non-ferrous Foundry, mainly aluminium; Midlands area; no reasonable offer refused; property on lease; owner retiring, health reason.—Box 302, FOUNDRY TRADE JOURNAL.

PATENT

THE Proprietor of British Patent No. 561012, entitled, "Locking Device for Load Supporting Pin," offers same for license or otherwise to ensure practical working in Great Britain.—Inquiries to SINGER, STERN & CARLBERG, 28E, Jackson Boulevard, Chicago 4, Illinois, U.S.A.

MACHINERY WANTED

WANTED.—Oil or Gas-fired Rotary Furnace; 5 to 10 tons capacity.—Offers with full details to OAKLAND METAL CO., LTD., Willington, Derby.

WANTED.—Rowland or Coleman 16 in. foundry type Abrasive Wheel Cutting-off Machine; must be in good order.—Box 328, FOUNDRY TRADE JOURNAL.

THE following wanted.—Secondhand Sand Mixer; in good condition; state price.—Box 324, FOUNDRY TRADE JOURNAL.

URGENTLY WANTED.—All types of Foundry Plant, including Sand Mills, Cupolas, Blowing Fans, Hand and Pneumatic Moulding Machines, Sand Mixers, etc.

S. C. BILSBY, A.M.I.C.E., A.M.I.E.E., Crosswells Engineering Works, Langley near Birmingham. Broadwell 1359

MACHINERY FOR SALE

FOR SALE.—EMB 12 Die-casting machine; complete with furnace and spares, including guard; practically new £800, ex-works; inspection invited; bargain.—Box 330, FOUNDRY TRADE JOURNAL.

FOR SALE.—Blower Extractor Fans. 230 volts, a.c., £16 10s.; d.c., £12 10s.—UNIVERSAL ELECTRICAL, 221, City Road, E.C.1.

FOR SALE.—One 400 lb. and one 600 lb. Crucible Tilting FURNACE; reconditioned exactly as new and guaranteed by makers.—Box 280, FOUNDRY TRADE JOURNAL.

FOR SALE.—One New Electric GOODS LIFT by Pickerings, Limited. Vertical travel, 19 ft. 6 in. Load, 10 cwts. Speed, 100 ft. per min. Cage 4 ft. 9 in. by 4 ft. 4 in., complete with all electrical gear for 400 volts, 3-phase, 50 cycle supply. This lift is brand new ex-works, and it has not been erected. Is suitable for goods lift or for cupola charging. Price, £750, or offers.—Box 244, FOUNDRY TRADE JOURNAL.